LIVE ARTICLES
ON
SPECIAL HAZARDS

No. 4

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Weekly
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ON

SPECIAL HAZARDS

No. 4

A Series of Articles Reprinted from the
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FOREWORD.

This is the fourth volume of articles on special hazards which we have issued since starting our monthly fire insurance supplement in THE WEEKLY UNDERWRITER. It is gratifying to the publishers, and complimentary to those who have contributed the articles of which these books are composed, that volumes two and three are at this date entirely out of print, and the supply of volume one is rapidly being exhausted. Insurance men are quick to recognize meritorious writings on trade subjects, and as this volume contains numerous articles touching upon various phases of the business the publishers bespeak for this book the same hearty welcome which was accorded its forerunners, and thank those who have contributed to its pages.

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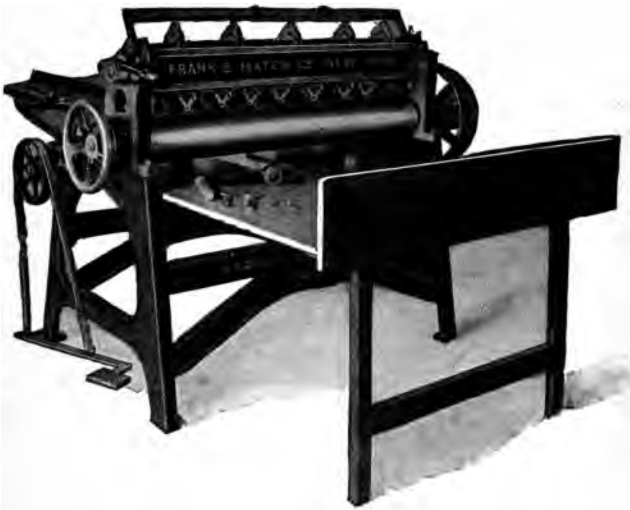
CONTENTS.

PAPER BOX FACTORIES.

Products, Processes and Hazards of This Type of Industry Described—Suggestions for Improvements—Salvage.

By Charles C. Dominge, Insurance Engineer-Underwriter.

The underwriter and the fireman have just cause for alarm when the news is scattered that a "paper box factory" is on fire. The fireman prepares for a hot fire, not easy to approach, owing



SCORING MACHINE.*

to the combustible nature of the stock, while the underwriter scratches his head, expecting a total loss.

TYPE OF CONSTRUCTION.

The paper box factory is usually located in an ordinary constructed "omnibus tenant" manufacturing building, with light,

* Illustrations by courtesy of Frank E. Hatch Company, 91-93 Thompson street, New York city.

worn, single floors, wood ceilings covered with canvas or paper, ordinary sash windows facing the exposing buildings and open well holes, dumbwaiter, stair and elevator shafts.

GOODS MANUFACTURED.

Card board boxes of all sizes and shape, whether round or square, mailing boxes with metal fasteners, metal or wood edged boxes, cigarette boxes, paper cans, combination cans, ribbon blocks and paper tubes form a few of the articles manufactured.

PROCESS OF MANUFACTURE.

The card board is first passed through a "scoring" machine, which cuts the same into the size required for the particular kind of box to be made. The cut board is then placed under what is known as a corner cutter, a machine which cuts out the corners.

The next operation consists of "setting up," i. e., putting gummed paper or linen on the corners by means of "corner stayers." Slitting machines then cut ordinary roll paper the required sizes to be placed on the stripping machines. These machines cover the rough card board with glazed paper, and the final process is called top-labeling, the topping machine covering the top of the box with paper, similar to the operation of the strippers. Some boxes are reinforced by ordinary wood strips, which are merely glued on to the card board, while others are reinforced by metal strips fastened on by large metal stitching machines.

FOLDING PAPER BOX STOCK.

The cardboard sheets are placed under large cylinder presses (similar to those found in newspaper offices), which cut and crease the card board at the same time. The cut and creased sheets are then taken to the nailing machines, where the wood frame is nailed on the cardboard, the wood parts having been first set into a form.

POWER USED.

Perhaps the most common power found in this class of risks is the gas engine. Care should be taken to see that the engine is set on a non-combustible or metal covered floor, with the edges curbed, to prevent oil running on the floor. If the enclosure is frame, metal should be placed behind the flywheel so as to prevent the scattering of oil. The exhaust chamber should rest on non-combustible material (not wood blocks, as usually found), and the exhaust pipe should enter chimney and extend through same to 6 inches above the outer chimney line. In the old style

gas engines the gas bag should be placed in a 3-foot lateral position from the gas flame, and an iron pipe connection should be substituted in place of the rubber tube to the igniter.

Electric motors should always be set on metal with the edges turned up at least one inch from the floor. Motors are oiled too frequently as a rule, and under ordinary circumstances oiling twice a week is sufficient. It is advisable that the motor be enclosed in a compartment lined with asbestos and metal, so as to prevent foreign substances from coming in contact with the motor, thereby keeping the surroundings clean.

Topping Machine.

It is important that the shafting be in alignment and the wooden pulleys be replaced with the modern type. The use of card board boxes tied under the bearings to catch the oil drippings should be positively prohibited, and metal drip pans substituted.

LIGHTING.

The lofts are usually lighted with open gas lights, some swinging against wood, others dangerously exposing the stacks of finished card board boxes. The protecting of the gas by wire cages offers only slightly better protection; therefore electric light is strongly recommended. The wiring should be kept free

from metallic substances, and no paper lamp shades should be placed over the globes. The

HEATING OF LOFTS

is in many cases by steam, although attention has been called lately to a very hazardous feature in the ordinary coal heated "Pot Stove." The stoves are made of an unlined iron casting varying in thickness from one-eighth inch to one-quarter inch and set on three legs. Many of the stoves are too small to properly heat the entire floor, and in consequence they are forced and the fire pot kept red hot. This condition causes the casting to crack. After these cracks appear the pressure from the heat and fuel

BOX COVERING MACHINE.

within spreads the opening, which soon becomes large enough to allow the burning fuel, sparks, etc., to fall out on the floor.

Any stove having an unlined fire pot and standing on three legs should be prohibited.

All coal stoves should rest on a metal covered base with the metal extending at least 24 inches in front and have a metal shield encircling same.

HAZARDS ENCOUNTERED.

The *gas flame is the most important* hazard in this class, and may be found directly under the glue trough in the rear part of

the "stripping" and "top labeling" machines. These are the only machines which have any heat attachments. Some of the automatic ending machines, stayers and special machines have cold plate troughs, where hand pasting is done.

Gas heated glue pots will also be found inserted in the wooden tables. In some factories kerosene stoves are found. *They should*

Box Printing Press.

be prohibited. Gas heated glue pots under wood benches should be guarded by metal casings at least 4 inches larger in diameter than the pots, the lighting hole through the casing to be at least one inch above the bottom of the casing and the woodwork of bench to be not nearer than 3 inches to the casing. The glue

should set in a water jacketed kettle, so that in case of the glue boiling over it could not come in contact with the naked flame.

The gas flame connected to the "strippers" and "topping" machines should have metal pans 8 inches in diameter placed under all burners, and the sides protected by metal flanges so as to prevent the card board parts coming in contact with the gas.

The glue heaters and mixers should be set on concrete or brick bases, and the kettles should be water jacketed and flange topped.

The hazard of this class will remain with us until the gas flame is entirely eliminated and steam substituted. In folding paper box factories a slight woodworking hazard is found, this subject being treated in detail in "Live Articles on Special Hazards," book No. 2. Some factories trim the boxes with celluloid; therefore this important hazard should be carefully looked into.

CARE OF REFUSE.

All clean card board and clean paper clippings should be freed from dust and dirt and placed in burlap bags and removed from the building as soon as possible. The dirt and sweepings should be placed in metal cans with covers, while all oily paper, waste from motor and machinery should be placed in standard riveted, self-closing oily waste cans. Cases of spontaneous combustion have been reported where the floors have been swept and all card board, oily waste, sweepings, etc., thrown in one large wood bin.

PRINTING.

If the boxes are printed inspectors should report whether the presses are of cylinder or job type, the floor they are on, whether the waste is well taken care of and benzine handled in safety receptacles.

STOCK AND FINISHED BOXES.

All stock should be placed on skids at least 6 inches from the floor, and no stock should be nearer than 2 feet from the ceiling. curbed, and no oil should be permitted to lodge in the pan. An aisle space 2 feet wide should be maintained, and the stock should not be allowed to block the hallways, windows or floor openings.

SALVAGE.

The best factor in this particular type of risk is the machinery; the next greatest salvage is derived from the card board storage. This property is always stored in cord bound bundles, closely piled and so compact usually that the greatest loss is found to be the water or fire damaged edges. These edges are usually cut off and the bundle remains marketable. The poorest part is the finished box stock and that in process of manufacture.

IN CONCLUSION.

Some of the up-to-date box factories may now be found in new reinforced concrete loft buildings, having all exterior window openings protected by approved wired glass windows in hollow metal frames and all interior floor openings protected by 6 inch reinforced concrete shafts with approved self-closing tin clad fire doors at all openings, and the entire risk protected by an approved two-source supply of "wet pipe" automatic sprinklers with standard supplies. Fire pails and extinguishers should be scattered throughout. In conjunction with the above, if the assured has a good commercial rating this business, which is now classed as "undesirable on account of its fire record," ought to become a fairly profitable one at a fair rate.

STORAGE OF NEWSPAPER STOCK.

The Right and the Wrong Way to Store Paper in Rolls. Susceptibility to Fire and Water Damage.

By Charles C. Dominge, New York.

The other day I was sent to report on a fire which took place in the sub-basement of the Scott & Bowne Building, corner Pearl and Rose streets.

The paper stock threatened was the kind used by newspapers—large rolls placed on end. The fire department arrived and used the "high pressure" with the usual flooding effect. I found the rolls of paper in about 5 inches of water, and was startled at what appeared to be a shot from a revolver. On examining a roll I found the bottom had burst, due to expansion. A search revealed the fact that nearly all the rolls were bursting, and I am told that if one happened to have his leg near a roll when the expansion takes place the force would be sufficient to break the leg.

The lessons to be learned are that although paper stock, in case of fire, would be very hard to destroy, yet the edges would be burned (stock must be recut and therefore size changed). Inspectors should always report whether paper rolls are below the grade floor and properly placed on skids.

The current issue of the *Publishers' Guide* (copyrighted) contains an address by John Norris, chairman of the American Newspaper Association's committee on paper, which gives much of value with regard to paper stock and its deterioration if not properly stored. By special permission we reproduce the following extracts:

The matter of paper preservation has attracted attention for centuries. Pliny says the ancients preserved their paper and books from moths by washing them with cedar or citron oil. In 1773 the Royal Society of Sciences at Göttingen offered a premium for the answers to questions relating to insects found in records and books. The answers accepted at that time indicated that five insects were destructive and that six appeared to be doubtful. They recommended that bookbinders use glue mixed with alum in place of paste. The ravages of insects vary according to latitude. The cigarette beetle has been described as *the most* destructive raider upon books. A publication entitled

"Bookworms of Fact and Fancy" gives a list of insects and includes: the bed bug, found in wood papers; white ants, found in clay fillers; roaches, after oils and fats in parchments; beetles, in skin bindings; springtails and silverfish, in dry and warm locations; centipedes and scorpions, which prey upon the insects found in libraries.

These promoters of paper deterioration may work considerable damage in warm latitudes, but in the important libraries which are located in the more northerly latitudes I believe their damage is negligible.

COMPOSITION OF NEWS PRINT PAPER.

News print paper is made by the mixture of approximately 75 per cent. of mechanical wood pulp and 25 per cent. of sulphite wood pulp, with a slight addition of clay and rosin.

The agencies leading to decay, according to my limited observation and study, are:

Artificial heat,
Gas combustion,
Sunshine,
Oxidation,
Excess of mineral substances,
Excessive dampness,
Carelessness in bleaching and inferior materials in binding.

Mechanical pulp will deteriorate rapidly when exposed to air or light. R. W. Sindall, an English authority, says many of the books printed on wood pulp paper, between 1870 and 1880, are in a hopeless condition. With lower grade papers containing mechanical pulp the degradation of color and fibre is inevitable. Clayton Beadle points out that paper which is brittle, when very dry, becomes stronger and more pliant with a certain amount of moisture. With more moisture it loses its power of "felting." There is a point where the maximum strength is obtained. Professor Herzberg, of the German Testing Institute, is credited with the statement that paper containing 3 to 5 per cent. of moisture is at its strongest. News print paper will absorb close to 10 per cent. of its weight in moisture. Most of this paper when manufactured contains about 5 per cent. of moisture or 100 pounds per ton of paper. It is liable to absorb 80 pounds additional of water per ton of paper in transit from mill to newspaper office. The additional weight of the paper when delivered has puzzled many newspaper publishers who almost invariably found that their rolls weighed more than the weight indicated at mill. A recent litigation in England disclosed the fact that jobbers had bought a less weight of paper than the customer had demanded, the jobbers relying upon the absorption of moisture in transit to make up the deficiency.

English librarians report that the ordinary novel printed on light, spongy paper has a life of about forty issues. In other words, it will be unfit for further use and not even worth rebinding after circulation among forty readers.

The American Chemical Society appointed a committee in 1908 to find a paper more suitable for the records of the society. It sought to ascertain the most durable, strongest, lightest, thinnest, most opaque and cleanest paper having a surface not injurious to the eyesight that it was possible to procure for the money available. The specifications adopted by that society were:

Rag, 75 per cent.
Bleached chemical wood or equivalent thereto, 25 per cent.
Ash (china clay), 5 per cent.
Weight (26x38, 500)—42 pounds.
Strength (Mullen), 15 pounds.
Folding number (Schopper) if practicable, 10 pounds.
Sizing, three-quarters rosin—no starch.
Finish, uniform machine, same both sides.
Color, uniform, natural, paper must be well washed to remove soluble salts and bleaching materials.

The paper cost approximately 6½ cents per pound.

UNITED STATES GOVERNMENT SPECIFICATIONS.

In 1904 Secretary Wilson, of the Department of Agriculture, authorized the Bureau of Chemistry to investigate the subject of suitable papers for Government purposes. The investigation covered about 5,000 samples of paper and resulted in the issue of two circulars by the Bureau of Chemistry. Subsequently the Joint Committee of Congress on Printing appointed a commission to pass upon this matter. Its report was adopted December 18, 1911, and now controls all Government supplies of paper and printing and binding materials. In the following month a public bidding was held. The standard specification for printing paper that would "endure indefinitely" was as follows:

Weight, 25x40, 500; 50-pound basis (24x38—45).
Thickness shall not exceed .0035 inch.
Strength shall not be less than 18 points.
Stock shall be not less than 75 per cent. rag; the remainder may be bleached chemical wood, free from unbleached or ground wood pulp.
Ash shall not exceed 5 per cent.
Size—The total rosin shall not exceed 2 per cent.

This quality of paper is comparatively cheap, costing 4½ cents per pound, or twice as much as the International Paper Company quoted as its news print price for the year 1912.

100,000 TONS OF PRINT PAPER ON HAND.

The print paper manufacturers of the United States carry

nearly 100,000 tons of news print paper, of which the supply at the mill averages:

40,000 tons, or nine days' supply for all newspapers of the country	40,000
Six days' supply in transit, equaling	27,000
Seven days' supply in places of consumption, equaling	31,500
Total	98,500

This total of approximately 100,000 tons of paper represents a selling value of about $3,500,000. Up to date there is no evidence of any general effort either by manufacturers or by consumers to standardize the method of storage or to improve conditions. Obviously it would be to their mutual advantage to encourage and promote every such effort.

The International Paper Company stores 1,800 tons of paper in the loft of the shed at Pier 39, North River, New York. The place is not heated in any way and it is subject to all the variations of temperature and humidity which are incidental to the free play of the air on the river front. Its officers say they can store paper rolls indefinitely in that loft (certainly for three years) and deliver the rolls to news paper consumers in good condition. Their only trouble in storing paper is due to one extra handling which is, however, less than cartage and storage in a warehouse. Some of the paper is stored in a warehouse in Franklin street, New York, in order that the company may not have all of its eggs in one basket. The Chicago *Daily News* stores 1,000 tons of news print paper as a reserve. Eighteen months ago during the pendency of a paper stike it used 600 tons of paper that had been stored for five years in a cellar that was open to the free play of the atmosphere. The rolls were set upright on strips that permitted ventilation under and on every side. The windows had never been closed in all that period. It is reported that when the stored paper was put upon the presses it ran better than fresh paper.

New York city uses 750 tons of news print paper per diem. The total tonnage stored in this city is not readily ascertainable. The Great Northern Paper Company carries between 8,500 and 9,000 tons at Pier 42, North River, to supply the needs of its customers. The International Paper Company now has approximately 3,500 tons in storage in its loft and on cars in the city. In Kansas City the *Star* carries 2,000 tons of paper. In Brooklyn the *Eagle* carries a month's supply

INTERNATIONAL PAPER COMPANY'S SUGGESTIONS FOR PRESERVING STORED ROLLS.

A. E. Wright, vice president of the International Paper Company, was asked for suggestions for storing paper in the new building of the New York *Times*. He answered as follows:

"Our experience has taught us that paper stored in a room of fairly even temeprature of from 30 to 40 degrees, with a free circulation of air at all times, is given the storage best suited for news print paper.

"As you no doubt know, the warmer the air the higher percentage of moisture it carries, therefore we suggest a temperature of from 30 to 40 degrees. When necessary to get as low a temperature as this during the summer months, we would suggest some sort of a refirigerating device through which the air would pass before entering the store room. It is well to avoid so far as possible excessive temperature and moisture conditions, and allow for as free a circulation of air as possible.

"We suggest the storing of paper on a ventilated platform fully 3 inches from the floor, this will allow circulation across the bottom of the rolls.

"As to the effect of light upon paper, we do not think that this has much bearing, so long as the wrappers are left on the rolls. We should say that the most satisfactory place for paper storage would be a basement with windows for ventilation on all four sides, and the paper stored on a platform such as recommended above.

"We feel sure from our experience in storing large quantities of paper in roll form that if our suggestions are followed out as outlined above, very little, if any, change in the character of the paper will be found after it has been stored for a considerable period."

It should be stated that no one has ever attempted to adopt refrigeration as a method of preserving stored paper rolls.

VERTICAL OR HORIZONTAL POSITION FOR ROLLS.

Another phase of this matter of storing rolls is the question of carrying rolls in a horizontal or vertical position. Practically all the paper companies and newspapers store the roll vertically because it seems to require less space. The New York *Times*, in planning its new annex, has aimed to store over 1,000 tons of paper and to preserve the horizontal position of the roll to avoid the waste and labor incidental to upending each roll and subsequent throwing of the roll to a horizontal position. In the Government printing office, five men have been observed helping to change the position of a roll.

Up to this time no effort has been made to collate the data relating either to the storage of news print paper rolls or the preservation of the printed paper. In the common interest some definite steps should be taken to improve conditions.

OILS AND VOLATILE SOLVENTS.

Nature and Derivation of These Liquids—Uses—Fire Hazards Involved in Their Manufacture and Use Pointed Out.

By William D. Grier, Special Agent North British and Mercantile Insurance Company, New York.

One of the principal fire hazards met with today is that of the various liquids, generally classed under the heading of oils and volatile solvents. Many fires have originated from the careless handling of some of these articles, and it is almost impossible to open a paper without reading of some accident of this kind.

Before going further into the subject it is well to understand a few of the principles involved and in doing so I will endeavor to present the subject as simply as possible, avoiding any matters which are not relevant to our business. I will consider first, the nature and derivation of the various articles; second, their uses, and third, the hazards involved.

Generally speaking, oils can be divided into three classes, according to their sources, namely, animal, vegetable and mineral, the latter class including those compounds which do not occur in nature but are manufactured.

ANIMAL OILS.

These consist of oils or greases prepared from the fat of various land animals, principally cattle, sheep and pigs, together with some which is rendered from the fat of horses and extracted from garbage and refuse. These oils and fats are known as tallow, lard, oleo oil, red oil, etc. They are used in the manufacture of lard for cooking, soap, candles, glycerine, artificial butter or oleomargarine and for the oiling of stock in textile processes.

The second class of animal oils consists of those derived from certain warm blooded marine animals and fish. From the warm blooded marine animals are derived seal oil used to some extent for illumination, whale oil from the blubber of the whale and sperm oil, which is taken from a cavity in the head of the sperm whale. Whale oil is used to some extent for the manufacture of soap, probably as an adulterant in some cases, and for other

purposes, the same as fish oil, for which its strong smell does not prohibit it. Sperm oil was formerly used to a very great extent for illuminating purposes and also as a lubricant and is used for this purpose today, but since the decline of the whaling industry caused by the discovery and utilization of petroleum, both for illuminating and lubricating purposes, the uses of sperm oil are comparatively limited.

Under the head of true fish oil is pre-eminently that derived from the menhaden or mossbunker, a fish which visits the northeastern coast of the United States in large quantities, giving employment to a large industry, particularly in Rhode Island and formerly on Long Island, although I believe the latter plants are mostly idle at the present time. Fish oil is used for a great variety of purposes, soap making, tempering steel, in the manufacture of many sorts of lubricating compounds, currying and as an adulterant or substitute for paint oil in certain classes of work, although for a good many purposes its peculiar odor and taste make it prohibitive. Chemically speaking, in common with some of the vegetable oils, animal oils are compounds of stearic or oleic acids with various bases and for some purposes it is necessary to break up this combination.

It is not my intention to go into all the manufacturing processes in which these articles are used, for that would take more time than the limits of a single paper would allow, but one very common example of the breaking up of an animal oil into its constituents is brought out in the manufacture of soap. Hard soap is, chemically, a compound of stearic acid and the element sodium known as sodium stearate, together with various impurities, adulterations, coloring or scenting materials. The first step in its manufacture and about the only one of importance involving a chemical process is the saponification of the soap stock. This consists of tallow or other suitable oil or grease which is heated in large steam heated kettles, sometimes under pressure, with caustic soda for the proper period, which combines with the stearic acid, setting free glycerine and various impurities. Salt is added to the mixture which causes the soap to separate from the liquor, consisting of water, salt, a large percentage of glycerine and various impurities, which is further treated to concentrate and refine the glycerine.

ANIMAL OILS HAVE PRACTICALLY LITTLE OR NO DRYING PROPERTIES in the ordinary sense of the word and, therefore, are not suited for use in the manufacture of paint or varnish except to some extent as adulterants. When exposed to atmospheric influences they simply become rancid or, in plain language, sour by reason of various chemical changes instead of evaporating or drying into a tough film as will be further described under vegetable oils.

Their hazards consist mostly in the fact that they are inflammable and furnish good fuel, together with the fact that the buildings where they are used in any quantity soon become greasy, dirty and oil saturated. This hazard, however, is offset by the fact that they do not at any ordinary temperature (that is, much below 250 or 300 degrees Fahr.) generate any inflammable or explosive gas and the spontaneous combustion hazard is comparatively slight compared to many of the vegetable oils which readily combine with oxygen. To my mind the hazard of various animal oils depends largely on the construction of the building in which they are used and whether fire heat or not is used in the process. For example, a building of ordinary frame or brick construction used, let us say, for a fish oil refinery or axle grease factory, thoroughly saturated with oil and grease, might be a very hazardous risk, especially in view of the common hazards of poor electric wiring and unsafe heating devices, which would quite likely be attendant in such a case. On the other hand, it is quite conceivable that a building of so-called fireproof or non-combustible construction, although occupied entirely for the rendering or use of animal oils and greases, entirely steam heated with specially arranged boilers and lighting devices might be, in itself, a very desirable and profitable subject of insurance because there is no aggregation of easily inflammable construction to bring the oil up to a temperature of ignition.

To summarize, the principal hazards of animal oil and grease risks are dirt and untidiness, quantities of other more easily inflammable material in the vicinity, and an exaggerated common hazard of heating and lighting.

VEGETABLE OILS.

The second great division is that of oils derived from a vegetable source. These are divisible into two principal classes, namely, volatile oils and fixed oils, types of these two classes being an essential oil, such, for instance, as turpentine or oil of lemon, which evaporates upon exposure to the air, and linseed oil, which does not evaporate but dries by quite a different method.

In order to understand the properties of various oils and solvents it is necessary to consider the radical difference in their behavior when exposed to the air and during the operation of drying, since in many cases the principal hazard develops in this process. When anything wet with water, alcohol, benzine and most volatile essential oils dries, it does so simply by the evaporation of the liquid. Thus when a solution of shellac in alcohol dries it does so by the evaporation of the alcohol, which leaves the shellac as a hard, glassy coating which can be scraped off and redissolved in alcohol.

On the other hand, when linseed or nut oils either by themselves or after having been boiled with certain gums, such as dammar, rosin, kauri, copal, etc., or in mixtures with white lead for use as paint, dry, they do so, not by evaporation but by entering into combination with the oxygen from the atmosphere, forming a tough rubber like coating which is something entirely different from the original oil which cannot be recovered again or utilized, as could, for instance, shellac or something which had been dried out by simple evaporation. These dry films of oil, varnish or paint can, it is true, be redissolved by being acted on by a strong alkali or chemical solution, but in that case they dissolve in the form of a soap and entirely different from their original state. In all varnishes and paints more or less volatile solvents, such as turpentine or naphtha, are added merely as a thinner or to dilute the thick mixture of oil, gum or white lead, serving primarily to make it thin enough to apply, aiding to some extent in the drying and in many cases as an adulterant.

When these drying oils or their compounds, such as linseed and various other vegetable oils, varnishes, furniture polish, are exposed to the air they absorb oxygen. During the absorption considerable heat is evolved. When this occurs by the slow drying of the liquid on a piece of furniture or, say, in a dish or vessel, the heat evolved is dissipated as fast as it is evolved, but when a piece of rag or cotton waste is wet with the liquid and allowed to lie in a mass or wad, especially in the case of cotton waste, where an enormous surface area is exposed to the action of the air and the heat generated is not dissipated, it will infallibly heat within a very short time to a temperature which will ignite it and the time required for this may vary according to circumstances from anywhere between one-half hour and several days. If the oily rag or waste is in a location where some preliminary heat can be furnished, as from a steam pipe, this oxidizing action will be accelerated, the action being somewhat camparable to that of a large mass, say a cannon ball, at the top of a hill or incline. It might rest here delicately balanced until some sudden jar or push started it down the incline and it would roll along gathering speed at every foot until at the bottom its energy would be very great. This is almost exactly what happens in the case of a wad of oily waste or rag. It may lie unnoticed in the corner for some time without any harm resulting, but if the circumstances are just right the process of oxidation will go on until perhaps in a short time the whole mass has gathered enough heat to be on fire.

THE VOLATILE VEGETABLE OILS MUST NOT BE CONFUSED with such things as benzine, gasoline or various chemical products. They are true oils, in most cases complex chemical com-

pounds peculiar to the plant from which they are derived, in nearly all cases having a strongly marked odor or taste, and when exposed to the air simply evaporate as alcohol or water would. They are, of course, inflammable but seldom or never constitute any hazard from our viewpoint because their use is generally restricted to small quantities.

Familiar examples of this class are oil of cloves, oil of lemon, peppermint, wintergreen and similar articles used in medicine and by perfumers, confectioners, etc. Most of these articles are quite valuable, some of them exceedingly so, as a very large quantity of raw material is required to prepare a small amount of the oil. It will not be necessary to consider further these products and we can, therefore, go on to the drying oils.

THE CHIEF EXAMPLE OF THIS CLASS

is the well-known oil expressed from the seeds of the flax plant known as linseed oil, which is a very valuable article of commerce and practically indispensable in the manufacture of paint and varnish. A drying oil known as Chinese wood oil is now being extensively used as a substitute for linseed oil. This is prepared from the nut of a Chinese tree and is sometimes called tung oil. Its drying qualities are said to be much superior to linseed oil. Soya bean oil is also used a great deal.

Probably the most important non-drying oil is that from the seeds of the cotton plant known as cotton oil. This is made in enormous quantities in our Southern States, its chief application being as a food product, a substitute for lard, olive oil and the like and in the manufacture of soap.

Next in the list probably comes olive oil, which is expressed from the pulp of the olive and is used, principally as a food product, to some extent in medicine and for some sorts of soap. None of these fixed vegetable oils involve any hazard from explosive or inflammable vapors as they in common with animal oils do not generate any such vapors until heated far above ordinary temperatures. They partake, together with animal oils of the grease and dirt hazard, are, of course, inflammable when heated to ignition point, but their principal hazard is from their proneness to spontaneous combustion when exposed to the air on rags or wiping material.

Before leaving the subject of vegetable and animal oils we might briefly review the methods of preparation which differ radically from those involved in the mineral or chemical oils or solvents. In the preparation of fixed animal and vegetable oils in nearly all cases the raw material in the case, for instance, of animal fat, fish, seal or whale blubber, is first cut up into small particles, heated or cooked by steam or hot water and the resulting mass pressed under great pressure, the oil trickling

out and then being received in suitable tanks. In the case of vegetable oils these are mostly prepared from the seeds of various plants, as, for instance, flax seed, cotton seed, the germ of corn, various nuts, such as peanuts and the like, by preliminary grinding or crushing, cooking the crushed mass by steam and pressing to extract the oil.

THE VOLATILE ESSENTIAL OILS

are prepared in a radically different manner, namely, that of distillation. The raw material, usually the leaves, stems or roots of certain plants, or in the case of turpentine, the liquid or sap which is drawn from the tree is distilled in suitable retorts or stills, the distillate being the essential oil.

In the case of some essential oils derived from trees of the pine family, also in the case of camphor (which is a true essential oil greatly resembling turpentine, although solid instead of liquid) chips or shavings of the wood are distilled with water, the oil distilling off and being caught in suitable receptacles. Peppermint, oil of cloves, wintergreen, etc., are prepared in much the same way, the oil floating on the surface of the condensed water in the reservoir and being skimmed off.

The essential oils are mostly prepared in a crude way near the spot where the plants grow. The manufacture of turpentine is a very large industry in our Southern States and to some extent in Russia and France, while in certain parts of New York State oil of peppermint is prepared by the farmers. The essential oils used in perfumery, such as oil of lemon, rose, etc., mostly come from eastern or southern Europe.

Before leaving this very interesting branch of the subject it is necessary to call attention to the fact that very nearly all of the essential oils are imitated by various chemical compounds, many of which are prepared from coal tar products. Previous to the passage of the pure food laws the adulteration was practiced to a very great extent, but now it is necessary to register all these articles and they are sold usually under their true name or so marked that no deception is possible except as in most cases of our every day life to the ultimate consumer, who drinks a glass of pineapple soda water flavored with butyric ether.

About the only volatile essential oils which are of any special interest to us are: First,

TURPENTINE.—This is a liquid distilled from the sap of several species of pine trees which are tapped in somewhat the same way as in tapping the maple tree for syrup. The turpentine is allowed to run into receptacles and distilled off somewhere in the vicinity of the place where it is gathered and shipped. Turpentine is a clear, more or less mobile liquid of

characteristic odor with a specific gravity of about .864 or, roughly speaking, about four-fifths of the weight of an equivalent bulk of water. It boils at from 311 to 320 degrees Fahr. and flashes at from 90 to 102 degrees Fahr. Turpentine is an exceedingly valuable liquid and it would be very difficult for the paint and varnish industry to get along without it. There are numerous substitutes which are cheaper, but none of them are as good. Its chief use is as a thinner and solvent in the manufacture of paint and varnish, although small quantities are used medicinally, generally in the form of a liniment, there being several well-known remedies of this type on the market which are probably nothing but old fashioned turpentine liniment.

While turpentine is quite inflammable and has a low flash point, it is, comparatively speaking, a safe article to use partly because its inflammable nature is well understood and partly because the vapor has probably a limited explosive range and has not the tendency to follow a draft or to stratify that the vapor of benzine or gasoline has. As far as my experience goes vapor explosions from turpentine are quite rare and even in such cases as I have known of have been caused by more than ordinary carelessness. The chief hazard of turpentine to my mind is the fact that it is very likely to be adulterated with naphtha, especially coal tar naphtha, which has many of the physical characteristics of turpentine, and on this account it is difficult to detect it by ordinary methods.

CAMPHOR.—This is a solid essential oil distilled from the wood of the camphor tree, a plant which grows largely on the Island of Formosa, where it is cultivated by the Japanese Government, which has practically a monopoly of the camphor trade. Camphor is a peculiar substance resembling turpentine in many of its characteristics except that it is solid. It is almost insoluble in water, but is very soluble in alcohol and other of the usual solvents. It is said to have a flash point of 125 degrees Fahr. and to take fire at about 140 degrees. It commences to evaporate at about 62 degrees Fahr., but there does not seem to be any reason for considering that an explosive gas is formed.

The question of camphor in storage has several times been referred to the speaker, but I have always considered that in the absence of other inflammable materials it is a very safe subject for insurance. It generally comes packed in wooden tubs or mats in a crude condition mixed with more or less dirt, sticks, etc., and has to be refined before it can be used. The refining of camphor is a very hazardous operation as usually practiced, namely, by solution in naphtha, settling out the dirt and evaporating the naphtha from the camphor, the naphtha being recovered.

The other method in use in this country is heating the cam-

phor directly to a temperature which causes it to evaporate and distil off, the pure camphor being condensed and recovered free from dirt.

The principal use of camphor is in the manufacture of celluloid and similar materials, although a considerable quantity is used medicinally and to some extent for the preservation of furs, etc., against moths.

MINERAL OILS.

We now come to the more hazardous class of oils and solvents, namely, those artificially manufactured, and the products of petroleum and coal tar.

In order to properly understand the nature and hazards of these articles it is first necessary to understand some of the terms which are constantly used in describing them. The hazards of these liquids depend on several factors which must be considered and weighed in their relation to each other.

The most important is: First, the "flash point." This is defined as the temperature at which the liquid evolves inflammable vapors; second, the "flame point," which is the temperature at which the liquid itself takes fire and continues to burn. This is usually considerably higher than the flash point.

There are a number of widely different methods of ascertaining these two points, some of which are prescribed by law in certain localities. They all, however, depend upon heating a specified amount of the liquid usually in a water bath in an apparatus of specified dimensions and in a certain specified manner. The temperature is read at prescribed intervals on a thermometer immersed in the liquid and from time to time a small flame or electric spark is passed rapidly over the surface of the liquid a short distance above it. When the flash point is reached a flame is observed to flicker above the liquid, immediately dying out. When the flame point is reached the liquid takes fire.

The principal difference in the methods is whether an open or closed test is made. In an open test the top of the oil receptacle is uncovered. In a closed test the vessel is covered usually by a plate of glass having small openings for the thermometer and the testing flame. The latter method is considered the most accurate and it has been found by very careful investigations that the flash point of the same oil as indicated by the closed test will be about 27 degrees Fahr. lower than in the open test. This, of course, is readily explainable as the vapor which is formed does not have the same opportunity to pass off as in the open test and the liquid is kept at a more even temperature.

At the present time a committee of the National Fire Protection Association, consisting of representatives from various inter-

ests, is endeavoring to lay out a uniform method of making these tests with a view to advocating its universal adoption.

The typical closed method, and the one which I will illustrate, is that prescribed by the State of New York with an instrument known as the Elliott tester. It consists of a copper water bath in which rests a copper vessel to hold the oil. This holds when filled to the proper mark exactly 10 ounces and was designed of this size originally because this is about the capacity of an ordinary kerosene lamp. Tests are made every two minutes after reaching a temperature of 85 degrees Fahr. This is in the case of kerosene and illuminating oil, to which, as I understand it, the provisions of the law apply only.

Perhaps the next most important point in relation to the hazard is the density of the vapor evolved or otherwise its weight relative to air and its diffusibility. These features are only ascertainable with the assistance of complicated apparatus and it would be impossible to demonstrate them at a meeting of this nature.

Inflammable vapors which are much heavier than air will, of course, settle to the floor, and travel along in an invisible stream in the direction of a draught, sometimes igniting at a flame which is many feet from the source of the vapor. This tendency to stratification considerably increases the hazard as the liability to form an explosive mixture or packet at low points is, of course, greater.

The next factor is the specific gravity of the liquid of its weight in proportion to the same bulk of water. This serves as an index to the hazard in the following way.

PETROLEUM AND CHEMICAL SOLVENTS

which we are considering are usually volatile and inflammable in proportion to their specific gravity, or in other words the lighter they are the more easily they vaporize. This, however, is not always the case.

Carbon bisulphide is 1.26 times *heavier* than water, but it is exceedingly volatile and its vapor is very inflammable, while, although chloroform and carbon tetrachloride are also much heavier than water and exceedingly volatile, their vapors are *not* inflammable so that the specific gravity can only be taken as a fair indication when applied to petroleum compounds such as gasoline, benzine, etc. It is ascertainable in various ways, the most accurate being by weighing a known bulk at a standard temperature of 60° Fahr. and comparing its weight with the same bulk of pure distilled water. For example a thin glass bottle or flask which is carefully graduated to contain exactly 1,000 grains of pure distilled water at standard temperature will be found to contain only 680 grains, or thereabouts, when filled

with gasoline or similar liquid and about 1,600 grains when filled to the same mark with carbon tetrachloride.

The more expeditious and generally used method, however, at least for ordinary purposes, is to use a hydrometer. A hydrometer is a glass tube furnished with two bulbs, one of which serves as a float and the other being filled with mercury, as a sinker. The stem is graduated in degrees and the weight is so adjusted that it sinks, we will say to the mark 1.000 in pure distilled water at 60° Fahr. In kerosene oil it would sink let us say to the mark .795 and so on, sinking deeper the lighter the liquid, the graduations being arranged so that the highest is at the bottom. It is usual to have several hydrometers adjusted for different points of the scale as it would be impracticable to have all of the graduations on one stem as this would require a stem of several feet in length. The hydrometer is usually graduated to read the specific gravity directly, but the form used mostly for trade or mercantile purposes is in the form of the Baumé hydrometer and is the one usually referred to in speaking of oils.

This hydrometer is on precisely the same principle as the direct reading instrument except that an entirely arbitrary scale is used starting at 10° for water at standard temperature and increasing up to 80° or 90°, which is the point at which it sinks in the highest grade of gasoline. This is, of course, purely arbitrary but can be reduced to terms of absolute specific gravity either by the use of a table or by a mathematical formula.

There is also a similar Baumé instrument made for liquids heavier than water which starts at zero for water. As a general rule whenever any petroleum product is mentioned as being of a particularly degree, it refers to the degree Baumé. Kerosene runs from 45° to 50°, benzine from 50° to 60°, naphtha from 60° to 72°, gasoline from 72° to 86°.

The first liquids to be considered are those derived from petroleum. Petroleum is a thick greenish oil occurring naturally in certain parts of the world especially in Pennsylvania, Ohio, California, Texas, Russia, in the Caucasus, Roumania and elsewhere, although the oil from different localities varies greatly in its characteristics. For instance, the petroleum from the central part of Pennsylvania has what is known as a paraffine base, while the oils from Texas and California are of an entirely different nature and appear to have more of an asphalt base. Russian petroleum has no great value for illuminating purposes but contains large proportions of lubricating and fuel oils.

PETROLEUM IS NOT A DEFINITE CHEMICAL COMPOUND

but rather a mixture of a great many different substances having different boiling points, and it is on account of this property

that it is possible to separate the different portions by fractional distillation.

Briefly, the process of preparing petroleum compounds is about as follows: Wells are driven in the same manner as an ordinary artesian well, down to the oil bearing stratum, and the oil either flows by its own pressure to the surface or is pumped up, received in rude tubs or reservoirs and transported by pipe lines to the refineries. The first operation at the refinery is to allow the oil to stand in large settling tanks where the dirt and water are allowed to settle out. The oil is then drawn off and passed to the petroleum stills, where it is distilled off into its principal fractions, practically three in number and known as naphtha distillate, burning oil distillate and lubricating oil, this being effected by watching the temperature and specific gravity of the distillate, turning each fraction into different tanks as distilled off. For example, the lighter distillates comprising the naphtha fraction boil at comparatively low temperatures from 65° to 350° Fahr. When the temperature of the still has reached this point and the specific gravity of the fraction is from 62° to 70° Baumé, the discharge pipe is connected with another receptacle and the kerosene distilled off at a boiling point of 302° to 572°, and density about 56° Baumé. This operation is carried on until the last of the kerosene has been distilled off. The residue is then transferred to the tar stills, so called, where it is re-distilled, the various fractions being taken off at the proper time.

Each one of the three fractions referred to is then further distilled to separate it into its various constituents; from the naphtha fraction the various grades of gasoline, benzine and naphtha are taken; from the burning oil distillate the various grades of kerosene are obtained, while from the residue lubricating oil, vaseline and paraffine wax are obtained. Each of these products has to undergo a further refining by treatment with sulphuric acid and caustic soda, washing with water, etc., to prepare the various grades of oil.

We are chiefly interested in the first, or naphtha distillate, as practically the only use of kerosene is for light and fuel, it having little or no value as a solvent, and the lubricating oils are practically non-hazardous. They have high flash and ignition points, most of them having to be raised from 300° to 500° Fahr. before they will take fire. They have no tendency to absorb oxygen and are, therefore, free from any spontaneous combustion hazard.

CONSTITUENTS OF THE NAPHTHA DISTILLATE.

are about as follows: Cymogene—Practically a gas at ordinary temperatures. Rhigolene with a boiling point of 65° Fahr. and resembling ether in many of its properties, and together with the next fraction known as petroleum ether, is seldom met with.

The first fraction of commercial importance is gasoline, which has a specific gravity of about .660 and boils at from 150° to 190° Fahr. Flashes at 60° to 75° Fahr. and its vapor weighs about 3.05 times as much as air and its explosive range is from 5 to 18 per cent. The next fraction, generally known as naphtha or stove naphtha, has a specific gravity of about 72° to 90°, and boils at from 160° to 210° Fahr. Benzine, which is the heaviest of this fraction, has a specific gravity of about 72° to 90° and boils at 225° to 300° Fahr.

These three liquids are probably about the most dangerous that are met with in ordinary practice and their hazards are pretty well understood generally. At the same time a great deal of carelessness is found very often. The principal use of gasoline today is as a fuel in motor vehicles, also to some extent for cleaning purposes. Naphtha, so-called, is used for burning in naphtha stoves and heating devices, in lamps, very largely for cleaning, and as a solvent for varnishes, rubber cement, the extraction of oil and numerous other purposes where a volatile solvent is required.

Benzine is used for cleaning and as a solvent and for all purposes for which its specific gravity and somewhat less volatility than naphtha or gasoline will permit. It is used very largely as an adulterant for turpentine and one of its late uses is as a denaturing agent for alcohol.

THE NEXT CLASS OF LIQUIDS TO BE CONSIDERED

are those artificially prepared. We will commence with alcohol. There are many chemical compounds which are classed technically as "alcohols," but those usually referred to by this term are wood or methyl alcohol, grain or ethyl alcohol, and potato spirit or fusel oil, known as amyl alcohol. Wood alcohol or methyl hydroxide is prepared from the distillation of wood, a good deal of it being made in the southern tier of counties in New York State. It is a colorless light liquid of characteristic smell and is quite inflammable, much more so than ordinary alcohol. The flash point is 32° and specific gravity .796—vapor density B. P.—1.12° to 149° Fahr. Explosive range of vapor about 4 to 13.6 per cent.

Grain alcohol, which is the ordinary alcohol of commerce is prepared by the distillation of fermented grain, usually by rectifying or refining whiskey, although there are processes now being followed for making grain or ethyl alcohol from the sugar prepared from wood refuse. It is, however, quite different from wood alcohol and must not be confused with it. Its flash point is from 78° to 143° Fahr., boils about 173°, vapor density 1.613.

The third kind of alcohol, amyl hydrate, known ordinarily as fusel oil or potato spirits, is prepared from the refuse of grain

alcohol distillation. This is an oily liquid of very offensive smell and occurs to some extent in raw whiskey. It is practically what puts the headache and to a large extent poisonous effect in whiskey or other liquids that have not been properly aged. In the aging of whiskey fusel oil or amyl alcohol is changed into other substances, which while poisonous are not nearly so much so as fusel oil. It is called potato spirits because a great deal of that on the market is prepared from the fermentation of potatoes in Europe. Boiling point .262, flash point 114.8, specific gravity .833, vapor density 3.147.

THE USES OF GRAIN ALCOHOL

are well known. It is an exceedingly valuable liquid for many purposes. Wood alcohol is used largely as a solvent in varnishes, lacquers, etc., and in many cases is a substitute for grain alcohol for everything but internal use, its poisonous qualities preventing this. Since the passing of Government laws on the subject a great deal of grain alcohol is sold under the name of denatured alcohol, this being simply ordinary grain alcohol containing about 10 per cent. of wood alcohol and about .5 per cent. of a low grade of benzine. These articles are used because they have pretty nearly the same boiling point as grain alcohol and are very difficult to extract after having once been mixed with it, so that having once been denatured it is not an easy matter to refine the alcohol so as to make it fit for drinking and, therefore, taxable. There are also some special formulas permitted by the Government for denaturing alcohol in cases where the benzine or wood alcohol would make it unfit for the purpose for which it is needed, such as adding some substances which give it an offensive odor or some peculiar color, blue for instance. These are only allowed in special cases.

Closely related to the alcohols are several other articles to which I will briefly refer.

ETHER.

There are many ethers known to science but the one most commonly used and usually referred to is the so-called sulphuric ether used as an anæsthetic. The name sulphuric is a misnomer, as ether contains no sulphur. It is, however, made by acting upon alcohol with sulphuric acid and distilling off the ether, hence the name sulphuric.

Ether or ethyl oxide is a colorless liquid about three-quarters as heavy as water, with a very characteristic odor, which once smelled is seldom forgotten. Its principal characteristic is its great volatility. It is highly inflammable and the vapor is heavier than air, so that it should be handled with great caution and never in the vicinity of an open fire or light. It is usually sold in soldered tin cans and in drug houses handling ether the solder-

ing process constitutes considerable hazard. The soldering is usually done with solder of a low melting point and an electric soldering iron, although there was a heavy loss about a year ago in Philadelphia caused by this very thing, the ether igniting from an electrical soldering iron. Strange to say there was a 600 pound cylinder of ether which went safely through the fire. The chief use of ether is of course as an anæsthetic, but it is used to some extent as a solvent.

Closely related to ether is a liquid known as ethyl chloride. This liquid is a gas at ordinary temperatures. It is stored under pressure in small tubes and used for local anæsthesia or freezing by dentists. It is also used in artificial refrigeration. It is not as hazardous as ether.

There are a number of ethers which are used as artificial flavoring extracts. I have a sample of one known as butyric ether, ethyl butyrate or artificial essence of pineapple.

ANOTHER LIQUID IN VERY COMMON USE

is known as amyl acetate or sometimes banana oil. This is prepared by acting upon amyl alcohol and acetate of soda with sulphuric acid and distilling. Its principal use is as a solvent, especially of nitro-cellulose or celluloid and in the manufacture of lacquer. Its odor is very familiar in connection with bronzing liquid for radiators and iron work. It is also used to a certain extent as artificial banana essence, and as a matter of fact it is really amyl acetate which gives the natural banana its characteristic odor, present, of course, in exceedingly minute quantities. It is very inflammable. Flash point 24-90° Fahr.

Acetone is a liquid related to alcohol, which it resembles in some respect. It is usually prepared by distilling acetate of lime and sometimes wood. It is used to a very great extent as a solvent, especially in the preparation of artificial and natural flavoring essences and many medical preparations. It is more inflammable than alcohol. Flashes at minus 32° Fahr. Mixes with water and mixture is inflammable unless water is 5 to 1.

I think, however, that the most inflammable and dangerous solvent met with in ordinary use is carbon bisulphide. This is a heavy colorless liquid weighing 25 per cent. more than water, prepared by passing the vapor of sulphur over glowing charcoal. It has an exceedingly offensive odor, resembling rotten eggs, and is used to a considerable extent as a solvent for rubber and in the extraction of oil from seeds. It is very volatile and highly inflammable, it being stated that this vapor will ignite between 200°-300° spontaneously. Six per cent. in air is explosive. Flashes at —20°. It is used also for disinfecting grain elevators to kill vermin.

There is another long series of compounds made by distilling

coal tar which is the residue from the manufacture of illuminating gas, from which is directly derived a great many substances such as solvents, dyestuffs, burning oil, medicinal preparations and so on, while its indirect derivatives seem to be almost without number. It must not be understood that all of these things exist in the coal tar. It is only because coal tar happens to contain their elements in such form that they can be readily altered into numerous combinations that we are able to obtain a great variety of substances. It is like having a numerical series of a great many figures which are loosely connected and can be arranged and re-arranged.

The two products of coal tar which are most commonly met with are coal tar naphtha and benzol, both of which are used as solvents, and also as bases for the preparation of other articles. Coal tar naphtha is used as an adulterant for turpentine and is sold under a number of fancy names. It is about as inflammable as turpentine, while benzol is very inflammable. Both should be handled with caution.

The heavy distillate from coal tar is known as creosote and is used mostly for the preservation of wood, and some grades are used to lay the dust on roads and in the manufacture of roofing paper. It is very difficult to say much about the hazard of creosote without considering the individual circumstances and examining a sample. I have inspected a number of samples at roofing plants and found them to vary from fairly hazardous, perhaps as dangerous as kerosene, to practically non-hazardous in their nature.

PAINT FACTORIES.

Ingredients, Formulas, Processes and Machinery of This Class of Risk Described—Common and Special Hazards Pointed Out.

By F. E. Roberts, Inspector, Norwich Union, Toronto, Canada.

The old formula for an ordinary paint is an intimate mixture of white lead used as the principal pigment or "body," coloring pigment, linseed oil, turpentine and a japan or "drier," containing more volatile than turpentine. No doubt this expensive formula is used today for the manufacture of some paint; but there is also no doubt that a large amount of paint is made in which substitutions, additions and alterations prevail in a greater or less degree. While there may be some additional hazard in grinding, if an adulterated linseed oil is used, the principal increase of hazard will be in the thinning stage. There the hazard of inflammable vapors is materially increased, owing to the fact that benzine may be a component part of thinners and driers and used directly as well. In fact, we may expect that more or less benzine, in some form or other, will be employed in the paint factory of today, and it does not necessarily follow that the factory using a small amount is less immune to fire than the one where a much greater quantity is consumed.

OILS.

Some of the oils that may be employed as adulterants of or substitutes for linseed oil are menhaden, cottonseed, corn and rosin oils, and recently an oil made from the Soya bean imported from Japan and Manchuria. Also by indirect processes linseed oil can be made to combine with a considerable proportion of water. It is said that petroleum products may be used as adulterants. One turpentine substitute prepared by distilling pine needles, young twigs and fresh pine wood is more hazardous than turpentine. There are said to be substitutes consisting wholly or in great part of petroleum products, which have as high a flash point as turpentine (about 100° Fahr.). However, there are also substitutes in which the flash is very much lower, and it is safe to assume that turpentine substitutes generally will be more hazardous, as regards giving off vapors at ordinary temperatures, than turpentine. Turpentine itself ignites easily, burns rapidly, has the spontaneous ignition hazard, and is a much more hazardous article of storage than linseed and like oils which

belong to the safe class in all respects except that of spontaneous ignition. Linseed oil stands at the head of all other oils in regard to this danger.

DRIERS AND JAPANS.

Driers used in the process of boiling linseed oil and manufacture of oleo-resinous varnish and japans are solid substances, principally salts of lead and manganese. The japan which may be employed as a thinner and drier in paint factories consists of linseed oil and solid driers boiled down at a high heat to a thick mass thinned out for use with turpentine or benzine. Japan for grinding japan colors is practically an oil or oleo-resinous varnish thinned with turpentine. The black japan, familiar in dip tanks, is essentially a black varnish of which asphaltum usually forms the base.

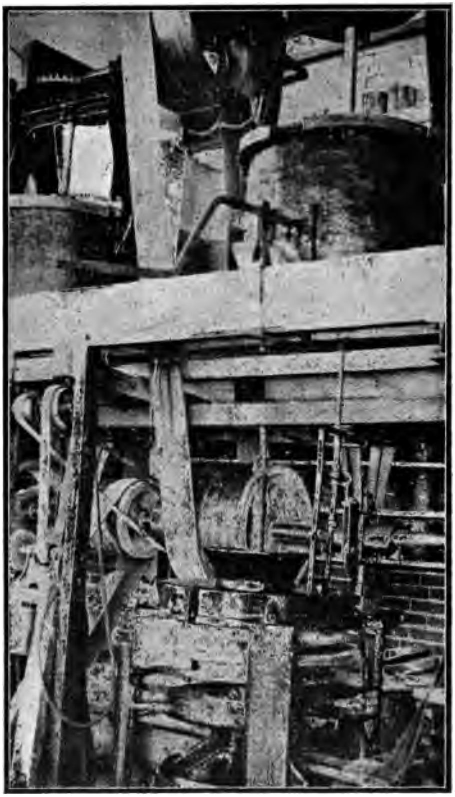


FIG. 1.—PUG MILL ABOVE. BUHR STONE MILL BELOW.

PROCESSES.

The process of making an ordinary paint consists of mixing pigments with oil, grinding such mixture to a smooth paste and thinning the paste to the consistency of

paint with oil, japan, turpentine or benzine. The resultant paint may be strained through wire netting and is canned either in self-sealers or soldered containers. Paste paint is the paste referred to above which is barreled and sold to various manufacturers who thin it out according to their own ideas. This is no guarantee that benzine will not be used, and may mean that conditions of such use are not so good as in the paint factory.

MATERIALS.

Painters' colors are coloring pigments ground to a paste in oil canned in that form. Coachmakers' colors are the same ground in japan. Paste fillers are a mixture of silex (ground quartz), pigment, oil and japan. Enamels are paints in which varnish takes the place of oil to a large extent. Varnish stains, sold under that name or under various fancy titles, are practically colored varnishes. Oil stains may be considered as a thin paint. Putty consists of whiting and low grade linseed oil containing water and mucilaginous matter incorporated together by an edge runner or "chaser." In some low grade putty a better description of the liquid might be mucilage contaminated with a little oil. Shellac varnish often called simply "shellac," is a product of most paint factories and consists of gum shellac, partially dissolved, put into a closed barrel which rests in a horizontal position on trunnions in each head, and is rotated slowly on its horizontal axis by power. Sometimes the trunnions are placed out of the centre in opposite directions which gives a "wobbly" rotation—quite appropriate for an alcohol container! There are some stains in which the liquid is practically all wood alcohol, benzine or some mixture of volatile material. Also "reducers" or "turpentine substitutes" are sometimes prepared in which there is a large quantity of such liquids. All of the above operations involving the use of considerable quantities of volatile material, possibly storage as well, should be done outside of the paint factory, and are so treated in a good establishment. No heating process whatever should be conducted in a paint factory, such as boiling linseed oil.

MACHINERY.

The machinery of the paint factory is all devoted to mixing and grinding. The first mixer, used to mix pigments and oil, is called a pug mill (Fig. 1). It consists of a vertical metal cylinder, closed or open, fitted with a vertical shaft which rotates an arrangement of paddles. The last mixer in which the ground paste is thinned is the same as a pug mill, only much larger and with a different arrangement of paddles designed to stir the mixture up from the bottom.

The principal form of grinding mill, sometimes used to the exclusion of all others, is the horizontal buhr stone mill. These mills are generally water cooled by means of a

water jacket on the upper side of upper stone and lower side of lower stone, through which running water circulates. They are under-driven, the lower stone only revolving.

Cone mills, an enlarged form of the ordinary hand paint mills, consist of a hopper with a loose convex bottom rotated on its vertical axis. Grinding is effected by corrugations in the lower inside edge of the hopper and the corresponding outside edge of bottom. These mills are out of date and are used only for coarse grinding, if at all. Steel mills, water cooled, somewhat similar in form to the cone mills but much better finished and with what appears to be a safer grinding action, are sometimes employed for grinding colors in japan.

Roller mills consisting of three rolls mounted in cascade form are seldom seen. Edge runners or "chasers" (Fig. 3) consist of a heavy wheel mounted on a horizontal axis or two wheels, one at each end of shaft, which travel slowly around a circular bed, giving a crushing and mixing effect to material placed in their path. They are sometimes used for incorporating a body pigment such as white lead with oil and are in universal use for making putty.

Paint machinery is all slow running. No machines operate over sixty revolutions per minute and some operate much slower; the high speed hazard does not exist.

COMMON HAZARDS.

The hazards of heat, light and power are very important, not only considered in the ordinary way but from the point of view of ignition of vapors. Heat may also effect spontaneous ignition. It is obvious that only steam or hot-water heating and electric lighting should be allowed.

The standard for lighting in places subject to combustible vapors should be enforced. The lights should be placed as high up as possible without long lengths of cord; every lamp should be protected by a vapor-proof bulb and a wire guard; and especially no light should be installed over a mixing tank or other place where vapors may possibly exist. A direct current motor which is always more or less subject to sparking, especially if unenclosed and set on the floor, is a hazard outside of any electrical defects. The induction type is the only proper form. In lieu of this the motor should be placed on a shelf and carefully enclosed.

The boiler house whether for heat only or heat and power, if not detached, should be absolutely cut off from the paint factory with no door opening to main factory. The admonition that steam pipes must not run behind benches or be otherwise concealed, often not carried out in other factories, should be absolutely enforced in paint factories. An oily rag that finds its way

under a bench may be harmless with no steam pipes near, but is liable to give an account of itself with the steam pipe.

SPECIAL HAZARDS.

The special hazards are as follows, given in the order of their prominence: Spontaneous Ignition, Ignition of Vapors, Direct Hazards of Manufacturing (as Grinding, Mixing, Canning and Straining), and Laboratory.

SPONTANEOUS IGNITION OF LIQUIDS.

This is due to the familiar presence of oily material which in paint factories will generally mean rags of any textile material which are necessary and must be used in considerable quantity, also packing material and rubbish which are not essential. "Oil" in this connection means any liquid used in a paint factory except benzine and alcohol and all paint products except such as contain no oil or turpentine—as shellac varnish. Rags impregnated with benzine, however, would generally contain considerable paint or oil and thereby become liable to this hazard.

The spontaneous ignition of any liquid in a container, covered or uncovered, of any paint product or of benzine vapor or any other vapor found in a paint factory is an imaginary danger. While it is quite possible to make a mixture of a pigment and linseed oil that would be susceptible to spontaneous ignition when not scattered over rags, etc., the ordinary ground paste, which may be left in containers or machines over night or Saturday to Monday, is not subject to spontaneous ignition, nor, indeed, is it easily ignited.

Standard waste cans should be required as a temporary receptacle for oily material, but the usefulness ends right there so far as paint factories are concerned. If not emptied at least every night, even a standard can is liable to prove a hazard, not a safeguard. A closet for employees' working clothes to insure perfect safety should conform to the following conditions: To be so arranged that spontaneous ignition of contents is improbable, and to be so constructed and located that if a fire occurs it will be confined to such contents and not endanger surrounding property.

SPONTANEOUS IGNITION OF DRY COLORS AND LAMPBLACK.

An oily rag dropped into a barrel of color or between barrels, or a small amount of linseed oil carelessly introduced would satisfactorily explain many cases of so-called spontaneous ignition that have been reported in dry colors. Opportunities for either of these conditions are not wanting, especially when a large number of barrels are in close proximity to operations of paint making. Some colors besides lampblack are probably not safe from ig-

nition when exposed to excessive heat, as mentioned, and it is not impossible for a spark in grinding to be unnoticed and packed away in a barrel, giving an account of itself later. But with proper conditions of storage and use, especially as regards contamination with linseed oil, the spontaneous ignition of painters' color, except occasional cases of lampblack, does not seem probable. Where lampblack is not too closely packed, kept free from contamination with oil (especially linseed), not subject to dampness nor exposed to excessive heat (as setting a barrel against hot steam pipes), cases of spontaneous ignition will be rare.

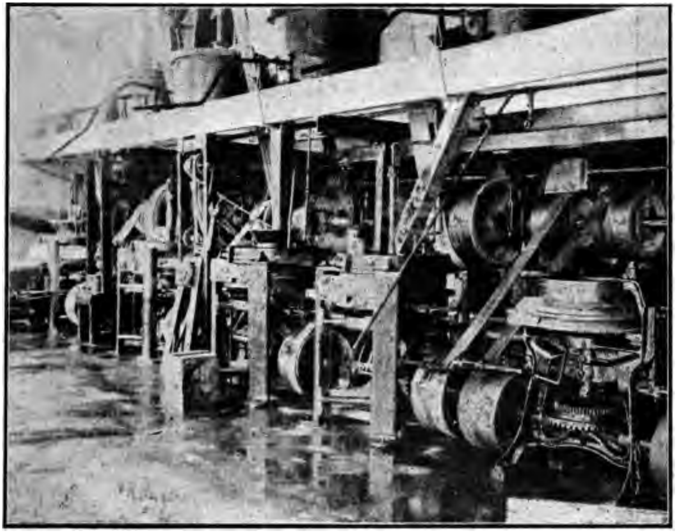


FIG. 2.—PAINT FACTORY—GRINDING.

The identical colors seen in paint factories are found in many other places, but so far as is known, the spontaneous ignition hazard seems to be confined to paint factories. It is usual to find a considerable stock of dry colors in paint factories, much more than the daily or even weekly needs of the business require even where such pigments as are used in considerable quantity, such as white lead, zinc oxide, barytes, etc., are stored outside. It is evident that this large storage is undesirable. The

stock is subject to all fires arising from other causes, and the larger the stock the more danger there is of "color fires" of the nature mentioned.

PAINT FACTORY FLOORS.

The constantly increasing layer of dried pigment and oil sometimes seen on paint factory floors is not very inflammable, provided it contains little varnish. But a floor once in this condition cannot be kept clean of the daily drippings and spillings of oil and more inflammable liquids which will ignite easily and burn quickly. A chance fire will be of a flash nature beyond any "first aid" appliances, possibly beyond those of the fire brigade.

IGNITION OF VAPORS

The atmosphere of a good paint factory is seldom in a dangerous condition. A supply system which does away with tanks and barrels of japan, varnish and turpentine (which last may be a much more volatile substitute), benzine brought in only as required and used at once, and covered mixing tanks are desirable conditions, but not always found. Vapors may exist at times even under such conditions, especially in the vicinity of mixing tanks. Workmen will be careless. Machines may be cleaned with benzine not used from safety cans. Therefore in good as well as in poor factories it is essential to allow no opportunity for a light or spark, so far as can be foreseen.

Outside of the ordinary exposure hazard from boiler room there exists the danger of fumes from the factory becoming ignited at furnace fires. An absolutely cut-off boiler room in a plant with steam power can easily be arranged and with proper construction can also be followed where steam is used for heat only. Otherwise it must be remembered that instances of benzine fumes igniting at 20 feet are numerous, and that they have been known to ignite at 40 feet, the latter, however, involving an amount of vapor hardly possible in even a fair sized factory. Also that a fire door which may be open is no safeguard against the hazard, possibly not if closed, with a vapor that hugs the floor. The same conditions apply to laboratories where gas flames may be found at any and all times and where ignition of fumes from the factory has been proved to be a fact and not a theory. Questions of convenience may prove a bar to an absolutely cut-off or detached laboratory. The best arrangement is where the laboratory forms a partial third story on a two story paint factory, the building being of fire resistive construction.

MANUFACTURING HAZARDS.

GRINDING.

In grinding with a buhr stone mill there is a tendency to heat, particularly in "hard" or close grinding, generally allayed in a

satisfactory manner by water cooling. The danger is from the mill "running dry," caused by a stoppage of the feed or by a dull and worn condition of the grooves whereby the paste does not ooze out freely. In this case the mill will heat up quickly, perhaps beyond control of water cooling, a spark may be struck, or heat alone rise to a point sufficient for ignition. With adequate attendance for the number of mills employed the danger is not serious. Other mills for the purpose and manner in which they are used probably present no more danger than the stone mill, and an edge runner or chaser appears to have no hazard at all.

FIG. 3.—EDGE RUNNER OR "CHASER."

MIXING.

A frictional hazard only applies to this process, and it would seem very remote except by some dislocation of machinery. A fire is said to have occurred in a mixing tank, though ignition of vapor from some outside source would be much more probable (in which case the tank would, of course, blaze up immediately), and could hardly be called a hazard of the machine.

STRAINING.

A fire occurred

in straining an enamel which was regarded by some as due to a spark from static (frictional) electricity. The process simply consist of running the material through a piece of wire netting or through a pan, the bottom of which is the same, possibly brass. There is a well marked hazard in the coating machine used in oil cloth and linoleum factories, of electrical spark from spreading knife, safeguarded by grounding the knife. Possibly those who see an intimate connection between the two processes may recommend grounding the pan.

CANNING.

The hazard of soldering the top of a can is due to the possible ignition of fumes through unsafe location of gas flame used to heat iron. While this may be so arranged that there appears but little hazard, an open light in a paint factory cannot be regarded with favor.

LABORATORY.

While operations are in a small scale performed by an operator who knows what he is about, there is, nevertheless, some danger of accidental fire. A small japan oven will be necessary for testing if a varnish and japan factory forms part of the establishment. The hazard of fumes from factory has been mentioned.

LIABILITY TO TOTAL OR SEVERE LOSS.

Where the factory is also a storehouse for all sorts of supplies, including liquids in barrels and ordinary tanks, and is besides a warehouse for manufactured products, the liability to total or severe loss is apparent. The remedy is to make the paint factory a paint factory, to detach or cut off the warehouse with its packing and possibly printing hazards, to remove all supplies except such as are required for daily conduct of business, and last but not least, to have a system of storage and use of oils, etc., which will reduce the chance of an uncontrollable oil fire to a minimum. It is self-evident also, with a factory on these lines, that the chances of any fire at all are greatly lessened.

FIRE PROTECTION.

This should consist of sand pails and chemical extinguishers, both of which should be required. Water casks and pails are not desirable. The only form of water in small quantities of any use in an oil fire is that from a chemical extinguisher, which has not only been proved to have some effect but is available to extinguish a small blaze before it reaches an oil. Sand will put out an incipient paint fire, and is besides useful in checking the flow of burning oil. Standpipe and hose are desirable, though effectiveness is lessened where oils are concerned by necessity of limiting size to such as an ordinary inexperienced man can handle; for if water is used, the larger the amount the better.

Oil fires of the linseed class are more amenable to extinguishment by water than petroleum products, though difficult enough when once under way. Where the area is limited and action by the fire brigade is prompt, a paint factory fire can be subdued even under somewhat unfavorable conditions.

Sprinkler protection in a good factory should be effective. In a poor factory it may or may not be, depending upon where the fire happens to start and the conditions for quick spreading.

CONSTRUCTION.

While the ideal form of construction for paint factories is fire resistive, yet a satisfactory factory can be made with standard mill construction. It is very desirable to have floors shut off. The shut-off should be absolute, there being no belt holes, chutes, nor other openings allowed. In any form of construction the building should not be over three stories in height and preferably two stories with no basement. Floors under paint machinery, if of wood, should be covered with metal.

Grease, Oil, Paint and Tar Fires.

Grease, oil, paint, tar or similar liquids or substances when on fire should be smothered with sand, ashes, dirt, chemical powder, wet bags, cloths, or similar substances or materials, when possible. Water put on oil, tar, paint or similar liquids or substances when on fire has a tendency to spread the blaze, and they will continue to burn on the top of the water.

For an oil stove fire, ashes, either wet or dry, or wet cloths, should be placed around, and if possible under the stove (without moving it), and the fire then smothered with wet cloths or bags. Any attempt to move an oil stove when it is on fire generally ends disastrously, as the moving of it causes the oil to spill and spread the fire or explode the stove. It is especially dangerous to carry an oil stove on fire into a hallway or other place where it will get a draught.

When the stove only is ablaze and there is nothing near it to catch fire, it is better to let it burn out gradually, protecting the floor with wet ashes, sand, dirt or wet bags or cloths.

THE PAINT INDUSTRY.*

Historical Sketch of an Ancient Trade—Analysis of Paint Ingredients—Fire Hazards in Modern Factories.

By Houston Dunn, Fire Protection Engineer, Philadelphia, Pa.

The paint industry is an ancient and honorable one. Where and when it got its inception no man knows. Doubtless the aboriginal man's innate love of color led to his adaptation of what lay nearest to his hand for the fulfillment of his desires. The history of all races in the use of paint is practically the same. The first pigments used are the natural earth colors or simple vegetable dyes, and commonly for heraldic or decorative purposes. The protective value of paint is a much later discovery. In some of the Egyptian ruins the colors are estimated to date back to 1900 B. C., 3,800 years ago. From the crudest article at that date the industry of paint making has developed until today it is, truly speaking, a science. To secure the ingredients entering into the make up of an ordinary can of paint, we have to search the world, as I will endeavor to show you in the development of this subject. Let us, therefore, briefly review the ingredients in a typical high grade paint formula.

ANALYSIS OF PEA GREEN.

(United States Standard Measure.)

	Per Cent.
Pigment by weight	48.00
Thinner by weight	52.00
	100.00
Thinner is composed of—	
Linseed oil	85.00
Asphaltum spirits	3.00
Turpentine	1.00
China wood oil	2.00
Japan dryer	9.00
	100.00
Composition of pigment—	
Basic carbonate white lead	15.00
Basic sulphate white lead	20.00
Zinc oxide	44.00
Magnesium silicate (asbestine)	3.00
Calcium carbonate	2.00

* Address before the Fire Insurance Society of Philadelphia, March 17, 1913.

	Per Cent.
Barium sulphate (blanc fixe)	10.00
Aluminum silicate	3.00
Lead chromate	2.30
Ferric-ferro cyanide	.70
	100.00
Coloring is composed of—	
Pure chrome green	100.00
Composition of Japan dryer—	
Kauri gum	1.67
Oxide lead	8.45
Manganese peroxide (black oxide of manganese)	2.00
Linseed oil	26.44
Turpentine	61.44
	100.00

For the benefit of those who especially desire to celebrate the seventeenth of March, let us consider it as

GREEN PAINT.

The commodity consists of 48 per cent. of pigment and 52 per cent. of thinner. The thinner is composed of five ingredients, of which linseed oil comprises 85 per cent.; the pigment of nine ingredients, of which the white leads form 35 per cent., and zinc 44 per cent. The coloring compound is pure chrome green. The Japan dryer is made up of five parts, of which linseed oil forms 27 per cent.. and turpentine, 62 per cent. Did you ever pause to consider where the articles in this formula come from, and the enormous number of other trades that are called upon to contribute toward the finished product as you see it upon the dealer's shelf?

For the thinner and dryer, we must draw upon the northwest and southwest United States for our linseed oil and turpentine; Albania, South America, the West Indies, Trinidad and Borneo for asphaltum spirits; China for the wood oil; New Zealand for kauri gum, and the Caucasus of Russia for manganese. For the majority of the divisions of the pigment, we do not have to go out of our own country, although much is imported from Europe in competition. And then the can—the tin of Cornwall seems to still hold its place as leader for quality, although Australasia and the Straits of Malacca exceed in quantity, and even the green color that we have decided to select, takes us to Asia Minor to secure the chromite, with which to make it.

And so you will observe we have pretty well circled the globe and engaged many semi-civilized people to contribute their labor to our simple can of green paint. Then, perhaps, we may have to lacquer a few knot-holes before we can commence painting. For the sellac, we must draw upon Siam, Bombay and China, and if we desire to finish up with some varnish, we must go into the wilds of Africa.

ALL THESE RAW PRODUCTS must be mechanically or chemically treated and mixed, and this makes the great paint industry of this country. Do you realize that $300,000,000 is invested in this trade, and that over 30,000 people are employed in its direct manufacture, not counting those in allied industries which contribute the component raw products, nor the thousands of dealers who distribute it to the consumers?

With this brief review of the scope and importance of the trade, we will pass to the important branches of manufacture. Broadly speaking, paint may be said to be a pigment ground or mixed in oil: varnish, gums melted and mixed with vegetable and mineral oils. As we have already observed, 35 per cent. of the pigment of paint is

WHITE LEAD,

and so it seems appropriate to treat of that first. History relates that it was first obtained in the carbonate form in small quantities by the Romans and was named "Cerussa." In the third or fourth century B. C. they produced artificial white lead by treating native blue lead with vinegar. This is in effect the same process as was adopted in Holland in the seventeenth century, and came to be known as the Dutch process. It has never been improved upon, although white lead is now also produced by what is known as the quick process and the mild process. As the Dutch process is most universal, we will describe it briefly. Desilverized lead pigs are melted and the molten metal distributed in shallow molds, and when set the lead is known as "buckles" from its shape. These are packed into earthenware pots having at their bottoms shallow wells containing each about a half pint of dilute acetic acid. The charged pots are arranged in tiers between layers of spent tanbark, where they are allowed to remain for 130 days. Chemical action sets in and continues through four distinct processes until the buckle has been converted into basic carbonate. It is then ground, washed, floated and dried. The quick and mild processes are much alike in that they both start with desilverized lead and use a steam blast and revolving drums containing carbonic acid gas. The finished product, however, is finer in texture than Dutch process, and requires a larger consumption of oil to mix. From a fire hazard standpoint there should be no real danger in any of these processes provided the drying pans are properly arranged. There is, however, a danger to the health of the workman. Pliny refers in one of his writings to the injurious effects of white lead on human beings.

RED LEAD

is largely used in paint making, but its preparation is much *simpler than* white lead. It also has historic associations, as it

was known to the Greeks and Romans under the name *minium.* Its manufacture consists of the oxidation of metallic lead in a reverberatory furnace. The oxide after removal from the furnace is ground, levigated with water and dried. The desired color is obtained by continuing the oxidation process. When the temperature is allowed to pass a certain point, the dross in the furnace will fuse and the well known product so much in use, litharge, will result. Any hazards connected with red lead burning would be practically the same as with white lead.

ZINC OXIDE

is our next most important ingredient. Zinc is peculiar in that it is the only metal in common use produced by distillation. The oxide is produced by two different processes; the "French" volatilizes the metal in a current of air and collects the resultant oxide in closed chambers, the "American" producing it directly from the ores. The nature of the ores affects the resulting oxide. Finely divided particles of the ores are mixed with powdered anthracite and charged into closed furnaces having perforated grate bars. Combustion is started in the anthracite and a blast of air forced through the perforated grate. The heat smelts the ore, volatilizes the zinc, and the metallic vapors combining with the oxygen of the blast produce zinc oxide, which is carried through a series of cooling flues and collected in fabric bags. This is the process used by the New Jersey zinc makers, from native ore, which incidentally is unique in that it occurs in commercially available quantities nowhere else in the world. I doubt if any serious hazards exist in the making of this commodity if the plant is properly constructed. Haste in barreling the product might lead to a rare hazard by placing the commodity in the container before the oxidation had ceased. I have been told of two cases of fire in zinc oxide barrels in jobbers' stocks and can attribute it to no other cause.

CALCIUM CARBONATE.

is another of our ingredients. It comes to us in two forms. One is the well known whiting, or Paris white, secured principally from the chalk cliffs of Dover, England. It is prepared quite extensively in this country by a process which consists of furnace heating, grinding, floating and drying, much the same as the making of red lead. Silicate of alumina is prepared in much the same way. Barytes is not included in this formula, but could be substituted for blanc fixe if desired. It is found chiefly in the central United States and is manufactured into pigment chiefly in St. Louis and other points in Missouri.

Our coloring matter being green consists of chrome yellow from lead chromate produced by the reaction of a soluble chromium salt on a soluble lead salt, both in solution, and

Prussian blue, the component of prussic acid and cyanide of potassium. The cyanides are obtained from dried blood, leather parings, etc., containing carbon and nitrogen. These are calcined with an alkali, washed, and the liquor recovered, or the blue may be precipitated with copperas. The making of Prussian blue is hazardous and should only be conducted in a building separated from the remainder of the plant or securely cut off by fire doors. Pure chrome green should be kept in storage in a separate building. As the processes are varied in making these colors, usually conducted by the dry color works, it would be well to look out for chlorate of potash, strong sulphuric or nitric acid and other chemicals susceptible to spontaneous combustion or burning with great rapidity and intensity.

IN OUR THINNER

we have 85 per cent. of linseed oil. This is secured from flax originally used only for the making of linen cloth. Today over 25,000,000 bushels of flaxseed are consumed annually in the manufacture of linseed oil, the great bulk of which goes into paint or varnish. The production is divided about equally between the Northwest United States and South America. Its storage and transportation utilize elevators, railroads and steamships; its use for oil making requires elaborate plants, much special machinery, and the treatment of the oil for its various uses involves chemistry and the mechanical arts. The flaxseed is first cleaned from foreign seeds and ground in a series of roller mills. The resultant meal is treated in a special heater with live steam to break up the oil cells. The hot meal is then pressed into the desired form and size for the oil presses in a cake former. A number of these cakes are stacked, one above the other, in camel's hair or other fabric cloths between the plates of a specially devised hydraulic press, and the expressed oil is filtered and collected in settling tanks; the pure oil collecting on top and being drawn off is raw linseed oil. The plants making linseed oil, from a fire standpoint, are good, bad and indifferent. The hazards are diversified and scrupulous cleanliness should be insisted upon.

TURPENTINE

is secured principally from the southern United States. The pine tree is notched or "boxed" periodically and the rosin caught in these boxes or in small vessels resembling flower pots. It is subjected to distillation and tepid water allowed to run over the face of the rosin as it becomes hotter and hotter in the still. Eventually large quantities of tupentine and water distil over. After standing the water settles and the pure oil is run off into barrels. Many plants are now being established to reclaim the turpentine in the roots of the pine trees and wood waste. This

is known as wood turpentine and when properly made there appears to be no practical difference in its properties as a paint vehicle from those of sap. In the making of dryer will be found

THE "BENZINE" HAZARD.

The conditions are practically the same from a fire standpoint as varnish making. For paint purposes the hardening of the linseed oil has been found to be facilitated by boiling it and adding manganese which seem to increase its absorption of oxygen.

Asphaltum spirits leads us into the refining of petroleum products, involving many interesting and complicated processes.

As the number of dry color works is comparatively small, we will not waste much time upon this subject. Particular attention should be paid to the dry rooms. Most of these are not as well constructed and protected as they should be. It would be well to also note whether the material on which the pulp is laid in the racks is paper or cloth. The latter I believe to be less hazardous, as the composition of paper as made today is uncertain from a chemical reaction standpoint.

Lampblack works are also few in number, but the finished product should be carefully stored to avoid contact with dampness or oil. Boneblack is largely used today and is made from phosphate of lime. It is not susceptible to the same dangers as lampblack. Bronze colors can be, and are, made up from metallic bronze mixed with a suitable medium of say twenty liquids and as one of these is a solution of collodion and amyl-acetate diluted with benzine, it makes us suspect that the others may be equally as dangerous.

A MODERN PAINT FACTORY

should be substantially built, and the manufacturing sections divided from each other and from the storage. The general practice has been to place a large container of linseed oil on the upper floor and draw by gravity as required. This is rapidly disappearing, however, and now linseed oil, as well as benzine, is being placed underground and is pumped up or blown by air pressure to a small tank containing a day's supply.

A prevailing bad practice is to have an open wood tub containing benzine in which the mills, brushes, knives, etc., are washed. I never saw a tub of this character which couldn't be got outside the building by exercising a little ingenuity. Batches of black should not be left in the mills over night. All platforms under mixers should be open and easily accessible, and the floor around the machinery covered with metal. In the jobber's risk I call your attention to a fire which occurred last year. The fire department on arrival found a bale of waste burning. No oils could have come in contact with it and the bale had not been opened. Tracing the purchase, it was found

that what was delivered for new waste was actually waste which had been reclaimed. The incident has suggested a new question in making a paint inspection.

Finally, on the paint question, so many special formulas are in use, and so many adulterants used, that the whole field of chemistry would have to be reviewed to enumerate them; so it will be an assistance if the general business standing of the manufacturer is first taken into consideration. It is safe to say that as the grade and price of the finished product descend in the scale, the fire hazard ascends. With one or two exceptions there should be no reason why a paint factory manufacturing high grade products should contain any more inherent fire hazards than any other industry.

The Chinese and East Indians have made varnish since time immemorial. Varnish coated articles were found in the ruins of Pompeii. The present process probably involves the same general principles enlarged by the march of science, but whether the varnish is more durable than that of the ancients is very questionable. Like paint, many adulterants are now used and the danger of fire generally increased thereby.

VARNISH

is made from any one of a number of gums principally imported from Africa and New Zealand where they are found in the earth much like our anthracite coal, and also like it are the fossilized remains of forests. The gum is placed in a large portable kettle and boiled with linseed oil to which a certain proportion of turpentine is added. The batch is constantly stirred while boiling, and when the varnish maker decides that it is ripe, the kettle is wheeled away from the fire and benzine is added to bring the solution to the required consistency. The modern varnish "stack" is built of brick or concrete, with a chimney for each kettle and metal hoods to be dropped over the kettle in case it catches fire. If it should, no damage will result unless the kettle is withdrawn from the chimney, thus endangering other kettles nearby. The thinning process is always attended with some danger and should be done outside, or in another building especially designed for this purpose. Another method is to have a kettle surrounded by a steam jacket instead of placing over an open fire.

SHELLAC

is a form of lac, which is a resinous incrustation surrounding the twigs of trees growing in Siam, India and some parts of China. It is dissolved for manufacturing purposes in alcohol in revolving barrels or drums, and when white shellac is desired, by boiling with a soda solution. There is no reason why the process should be hazardous.

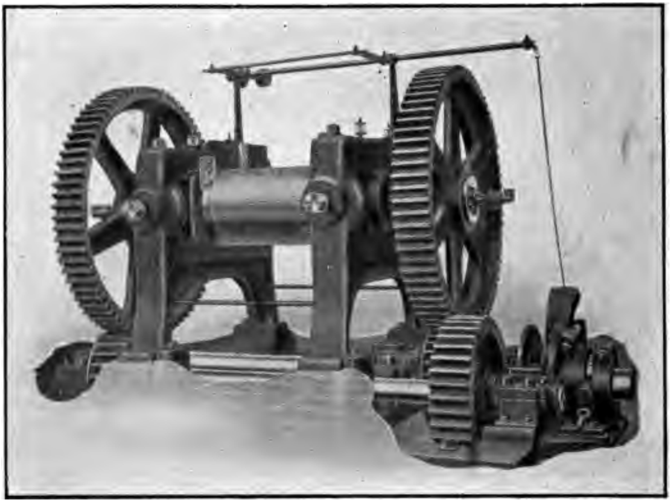
It is my opinion that automatic sprinklers will efficiently cope with fire in the paint trade and its allied branches, with the exception of the refining of crude petroleum. There is a strong prejudice against sprinklers in varnish works. This is due to ignorance. They will extinguish, and have extinguished, varnish fires successfully, even in the thinning room. When some genius adapts a system of sprinkler equipment wherein the liquid shall be carbon-tetrachloride instead of water, it is my belief that fire losses in classes using volatile liquids can be eliminated almost entirely. A good supply of sand and shovels should be maintained at all varnish works, and chemical extinguishers have been proved of great value. Where a highly combustible stock is involved it is always of the utmost importance not to allow the fire to gain headway. Anything, therefore, that will tend in this direction may be favorably considered. Allow me, in concluding, to suggest that in making an inspection in the paint trade you bear in mind that the manufacturer knows already a great deal more than we ever will about the chemical and mechanical fire hazards of the industry, and it is doubtful if we can make many suggestions along these lines that will not arouse his antagonism. Where we can be of the greatest value to him, however, will be in supervising his housekeeping, electric wiring and other things of a like nature which we call "Common Hazards," and calling his attention to dangerous practices that have crept into his establishment without his knowledge or realization of their importance.

THE RUBBER RECLAIMING INDUSTRY.

History of Reclaiming—Processes and Hazards Pointed Out.

W. H. Roberts, of Liverpool, England, in Norwich Union Magazine.

The rubber industry, as we know it, dates back to the year 1839, when Goodyear discovered that rubber, heated with a proper proportion of sulphur, was rendered far stronger, more



DOUBLE GEARED CRACKER.
(*Courtesy Birmingham Iron Foundry, Derby, Conn.*)

elastic and less sensitive to heat and cold. This process of treatment has since been known as vulcanization.

Useful as this process was, it nevertheless had the effect of introducing an awkward problem, the problem of waste. Up to

this time all rubber had to be used in its natural state; that is, without vulcanizing, and it was easy to utilize factory waste, rubber trimmings, etc., by milling them up with fresh material, but when vulcanization came in all this was changed, for vulcanized rubber is no longer plastic and simply crumbles in the rolls.

As time went on this drawback became more and more evident, and while there is no very detailed history to appeal to, it is certain that many attempts were made quite early to devise some way of utilizing both factory waste and worn-out goods.

Scrap that was free from cloth and other fabric was ground fine and milled in with fresh material and good results were obtained on vulcanization, so that more or less scrap has been treated in this way ever since.

The most serious problem was presented by the so-called "inserted scrap" (such as hose, packing, etc.), which contains cloth and which cannot be ground and milled with fresh material except in a very few special cases. This is the problem that has developed

THE MODERN RECLAIMING INDUSTRY.

The first thought is to get rid of the cloth and this has been solved in three ways:

(1) The scrap is ground finely and subjected to a strong current of air by which the fabric is carried away and the rubber substance left behind. This rubber substance is then mixed with a small quantity of resin oil and steamed to render it plastic. This process (the "mechanical process") has been, and is still, employed on a very large scale.

(2) The scrap is ground, and then boiled for a few hours with diluted sulphuric acid. This destroys the cloth. The remaining rubber substance is then steamed with oil. This is known as the "acid process" and enormous quantities of scrap rubber, especially shoes, are thus treated.

(3) The scrap is coarsely ground and heated under steam pressure with a dilute solution of caustic soda for some hours in large cylindrical jacketed vessels called "devulcanizers." This destroys the fabric and dissolves out any uncombined sulphur that may have been left over from vulcanization. It also dissolves out or destroys some of the resins, oils, etc., that may have formed part of the original mixing from which the goods represented in the scrap were made. After this treatment the rubber substance is washed carefully to free it from alkali and then dried and milled into sheets.

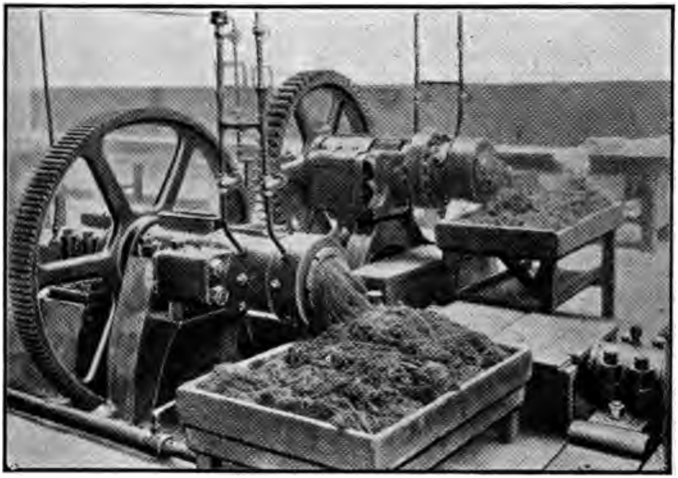
Before going into any further details it would perhaps be well to make a few remarks concerning what has been styled the "rubber substance," or the product that results from these various

methods of reclaiming and which represents what is left after the fabric is removed.

RUBBER GOODS ARE NOT ALL RUBBER

except in some few exceptional cases; a larger percentage of the weight is made up oils, resins and mineral powders such as zinc oxide, barytes, whiting, etc., besides always the sulphur required for vulcanization.

The reason for this is not wholly a desire to cheapen the product. It is a fact that only by weighting and "compounding" the rubber with these various added materials can it be brought into



RUBBER STRAINING MACHINE.

a state where it will meet both service conditions and market requirements.

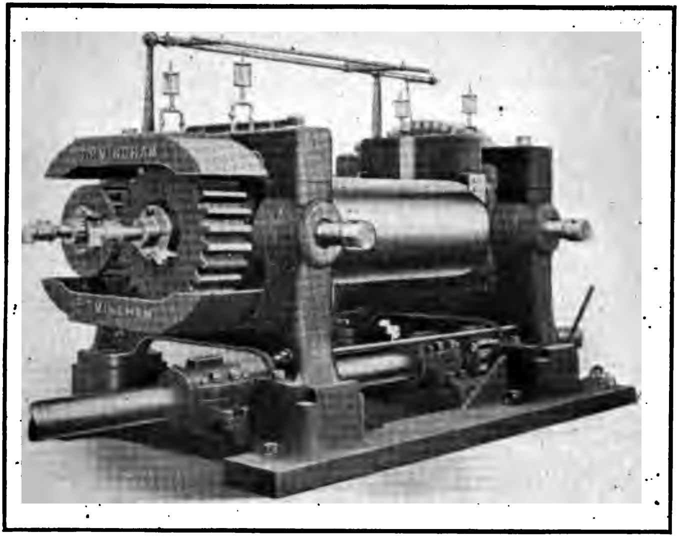
A motor tire tread is not pure rubber but is "compounded," mainly because this gives a better wearing tread—all things considered; and every class of rubber goods is "compounded" just as is dictated by the peculiar conditions of service to which it is subjected.

Now, when the scrap is reclaimed by one of the processes before outlined, what is obtained is evidently not pure rubber, *but consists* of the rubber that was originally used together with

the greater part of the compounding materials that were added. I say "the greater part" because some are removed in the reclaiming process.

For example, in the "acid process" such mineral powders as are dissolved by sulphuric acid will be removed, at least, partially.

In the "alkali process" some mineral powders will be removed by the hot caustic soda solution, and various resins, oils, etc., are displaced as well, but in general the "rubber substance" is not very different from what it was when originally mixed to make



ROLL MILL.
(Courtesy Birmingham Iron Foundry, Derby, Conn.)

the goods. It can be treated, in fact, much as if it were back in its original state and ready to begin over again, that is, enter into the manufacture of fresh goods once more. For this purpose it may either be mixed with freshly made material, or it may be simply used by itself in precisely the same way as the original material was used, without any addition except the necessary sulphur for vulcanization.

The first of these two methods is the more common, but the second might be employed much more frequently than it is.

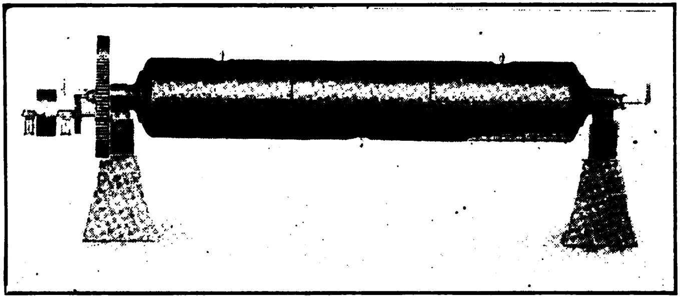
All the methods already outlined have this

GENERAL CHARACTERISTIC,

they are more successful with medium grades of scrap than with the very best; that is, the product obtained represents a larger percentage of the original merit of the mixing used to make the goods.

Many attempts have been made to devise methods by which the purest and highest grade scrap may be reclaimed to advantage, and a large number of patents have been granted.

Thus far the results have not been very conspicuous, but the problem is not beyond solution, and results are sure to appear in



ROTARY DEVULCANIZER.

(Courtesy Biggs Boiler Works, Akron, Ohio.)

time. Most of the patents involve solution of the scrap in some solvent, and clarification of the solution either by filtration or by settling.

This gets rid of the mineral substances. The solution is then mixed with some other liquid, such as alcohol or acetone, which does not dissolve rubber, with the result that the rubber in solution is thrown out or "precipitated," as the term is, the resin remaining in the solution.

The product is then boiled with water to free it from the solvent and precipitant, then sheeted and dried.

Whatever method is followed there are certain processes of refinement and purification to which the rubber substance must always be subjected.

Scrap rubber is usually not very clean; it contains sand and dirt of various kinds besides metal—for example, the studs in

the treads of motor tires, wires of cycle tires, metal couplings and nipples of hose, the nails and eyelets of shoes.

VARIOUS METHODS OF GETTING RID OF METAL

are employed, and so far as possible, the scrap is gone over before being ground, and any such foreign matter is either cut out or picked out, the studs being removed from motor treads, the wires cut from cycle tires, etc.

Then, after being ground, the scrap is sometimes passed over a magnetic screen or separator to remove bits of iron or steel.

As a still further precaution the rubber substance may be carried by a stream of water through a long, narrow trough, fitted with cross-cleats which tend to catch the heavy bits of metal while the rubber goes on.

Later in the process, after the rubber substance is washed and dried, it is often passed through refining mills which reduce it to exceedingly thin sheets, and more or less metal may be again picked out; and last of all straining machines are employed.

These are constructed on the principle of the forcing machine, the product being forced through a steel shell pierced with very fine holes, with the result that all except the most minute specks of metal are eliminated, the result being a surprisingly clean and satisfactory product.

The attitude of manufacturers of rubber goods toward reclaimed rubber varies in different countries. The United States of America has always been and still is the leader and vastly more is used there than in all the rest of the world put together. Russia, Germany and France follow, though at some distance. Britain has thus far shown little interest, but there is no doubt as to the future of the reclaiming industry here or anywhere else, for history is bound to repeat itself, and all past records have shown consistently that in proportion as reclaimed rubber comes into the factories, the quality of all medium grade goods grows better and the prices go down.

With regard to the fire hazards aspect it will no doubt be noticed that I have so far said nothing, as I think I might safely leave that point to the judgment of my readers, who, being for the most part fire insurance trained men, will readily see that the processes involved are not of a particularly hazardous character.

The devulcanizers, perhaps, require the surveyor's first attention, owing to the great heat employed; then again the piles of partially recovered rubber necessitate careful inspection, for in a few grades I have noticed there is occasionally a tendency for spontaneous heating to be set up if such piles are allowed to remain undisturbed for any length of time.

All wood floors should therefore have portions protected with fireproof shields or slabs upon which such stock can be placed when necessary.

WOOD-WORKING PLANTS.

Descriptions of Construction, Machinery, Operation and Output of This Class of Risks—Fire Hazards Pointed Out—Suggestions.

By T. Z. Franklin, With Underwriters' Association of the Middle Department, Philadelphia, Pa.

This subject covers such a wide range that in writing it up as a general proposition one cannot well follow to the end every side path nor attempt to do entire justice to the subject as a whole in one short paper.

We will, therefore, attempt to keep in the main path and treat with only those conditions that are found in woodworking risks as a whole.

THE COMMON HAZARDS ARE:

(1) Heating.
(2) Lighting.
(3) Power.
(4) Boilers and Fuel.
(5) Sweepings and Rubbish.

We will consider these under the various headings, taking the fire percentage of each on a basis of 500 fires, outlining the principal features, and their proper arrangement from the fire protection standpoint.

HEATING.

is commonly done by means of direct steam, hot air or stoves. Direct steam is used through the medium of a system of piping throughout the plant, using either live or exhaust steam, usually the latter. This method is safe if proper precautions are taken to keep inflammable materials from coming in contact with the pipes. All piping and coils should be suspended by iron brackets, and properly bushed where passing through any woodwork. When coils are located at sides of a room it would be advisable to provide a substantial screen to prevent stock or other material coming in contact with pipes.

In "hot air" systems air is drawn through heating coils by a large blower or fan and distributed throughout the plant through metal pipes or ducts. This type of heating system is more likely to give trouble than is the direct steam method. Its principal faults are the possibility of coils being mounted upon a combustible foundation or located within a wooden enclosure; the possi-

PAINT DIP TANKS WITH AUTOMATIC METAL COVER. WEIGHTS HELD UP BY ROPE OVER TWO PULLEYS HAVING FIVE FUSE LINKS. COVER CAN BE CLOSED WITHOUT DISTURBING WEIGHTS.

bility of dust, etc., being carried by the air and deposited on the coils; possibility of fire resulting from poorly arranged or carelessly maintained fan bearings, the fact that pipe openings are necessary in walls and floors, which would readily carry fire to upper floors in case of trouble occurring in one of the lower floors. It is practically out of the question to provide effective automatic fire stops in such blower pipes.

The use of stoves has practically been abandoned in modern manufacturing plants. Their use should be discouraged wherever found, even though care has been exercised in setting and locating them.

LIGHTING

systems in common use are electric, natural and manufactured gas, gasoline gas and acetylene. Oil lamps are very rarely used and where found should be replaced by a more modern method. When not installed and maintained in a standard manner an electric lighting system may become extremely hazardous. Installations in woodworking plants should preferably have all wiring run in iron conduit with fuse and distributing panels properly enclosed in locations free from dust and inflammable vapors. No fuses should be provided in the rosettes, and keyless sockets only used. In dipping and varnishing rooms vapor proof globes should be used with all lamps permanently fixed in position.

The principal dangers from use of natural and manufactured gas are the open gas flames being located near inflammable materials. Under no conditions should gas lighting be used in rooms where dust or inflammable vapors are apt to be present.

Gasoline and acetylene gas systems when properly installed are probably no more hazardous than ordinary gas lighting. This would be true only when gasoline gas machines having outside carburetors are used, or if acetylene, when the generator is located at a sufficient distance from the factory buildings to be safe.

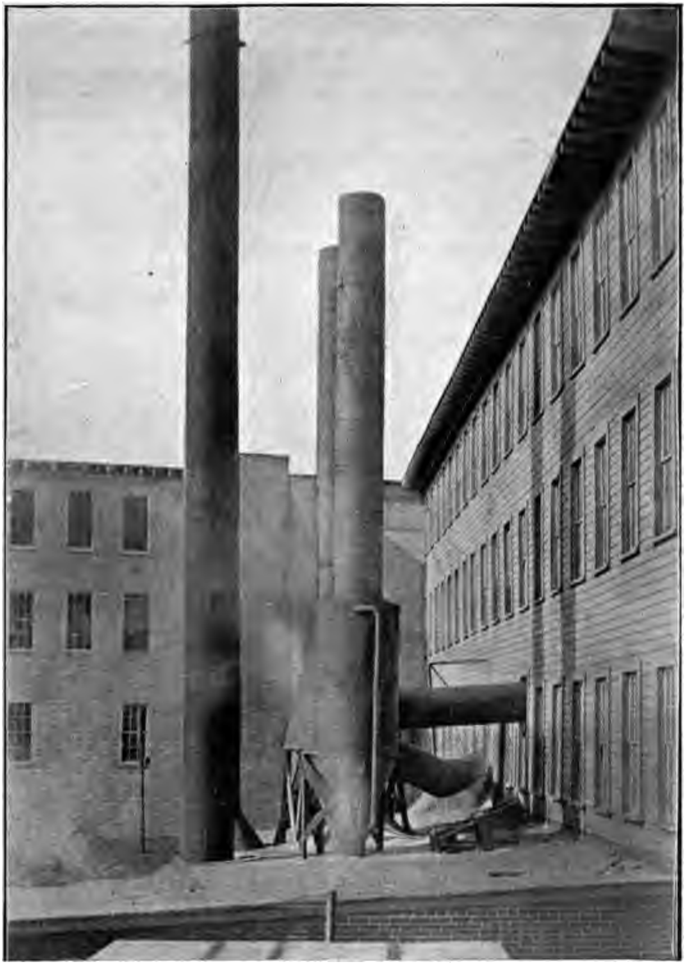
Fire percentage of lighting systems is about one per cent.

THE COMMON FORMS OF POWER.

are steam, electric, water, and gas or gasoline engines. The steam engine is the one most commonly used with belt and shaft transmission.

Electric power is coming more and more into favor, and where installed under standard conditions is probably the safest type to use. In the main woodworking portions, individual motors at each machine should not be used. While this might possibly allow of greater economy in operation where all machines are not constantly in use, it is very difficult to keep such motors clean and free from dust accumulation with the attendant hazard.

A properly installed and operated gas engine with electric igni-



Two Cyclone Dust Collectors Above Roof of Boiler House. Note Chimney-like Extensions for Carrying Fine Dust Above Roof of Plant.

tion is probably of no greater hazard than the ordinary steam engine. Gasoline engines, of course, introduce the gasoline hazard and when used should be of the best type with all gasoline stored outside the building, and the entire equipment installed in a standard manner.

A hazard incident to all forms of power is that of shafting and pulleys, and is entirely one of excessive friction. This may come from various causes, such as shafting out of alignment, insufficient lubrication, poorly fitted journals, belts in contact with woodwork or slipping on wood rimmed pulleys. The management and housekeeping of the plant are usually to blame for fires

PAINT DIP TANK SHOWING AUTOMATIC COVER ATTACHMENT. FUSE LINK HAS PARTED AND WEIGHT IS HELD UP BY STICK.

resulting from power equipments, at least in so far as hot bearings, frayed belts, etc., are concerned. Fire percentage credited to power is about 3 per cent.

THE BOILER PLANT

is too often located and constructed without proper consideration having been given to the hazard. The introduction of schedule rating is beginning to bring about changes for the better in this regard, but the work is slow. A fire percentage of 23 per cent. would indicate the necessity for more attention being given to the control of this hazard. Of course this high percentage is partly due to the hazard incident to the burning of such materials

as shavings which cannot be entirely eliminated regardless of precautions taken.

The principal things contributing to the high percentage are faulty structural conditions, so-called "back draughts," faulty boiler settings, unsafe boiler stacks, improperly located or constructed shavings vault, and dust accumulation on boilers or roof of boiler house.

The boiler house should be constructed wholly of non-combustible material, and properly cut off from the balance of the plant. The fire percentage of

CYCLONE DUST COLLECTOR. LEADS TO SHAVINGS VAULT THROUGH LEFT-HAND PIPE AND TO FURNACE FIRES THROUGH PIPE ON RIGHT. PIPE THROGH WINDOW RETURNS REFUSE FROM FLOOR OF BOILER ROOM TO CYCLONE.

RUBBISH, SWEEPINGS AND OILY MATERIALS

is about 3 per cent., and these fires are largely of spontaneous origin. They can usually be traced to careless housekeeping, failure to promptly remove piles of rubbish and sweepings, and accumulations of dirt and dust in places not readily accessible to the cleaner. Incombustible clothes closets should be provided for workmen's clothing.

Eliminating from consideration sawmills and veneer works, where logs are used, the

PRINCIPAL RAW STOCK IN WOODWORKING PLANTS

is lumber. The principal processes are lumber drying, machine and hand woodworking, finishing, packing and storage.

The fire percentage credited to the kilns is 14 per cent. There is hardly any other part of the average woodworker which has received less attention in the way of safeguarding the hazard than has the dry kiln.

In the older plants the kilns were located in the most convenient place, and very little if any attention given to other points than accessibility and economy of operation. The kilns mainly found are of two types. In the first the heat is obtained from steam coils located usually at the bottom of the kiln, using live steam where green lumber is being dried. The other uses blower and coils which are usually located in a small room adjoining the kiln.

THE COMMON DEFECTS

noted in kiln construction are light wooden roofs and finish; hollow walls and roof space; the use of wooden ducts for carrying the hot air into kiln; poor location and arrangement of blower and coils: improper supporting or arrangement of steam pipes which allow pipes to rest against woodwork or lumber, or dust and refuse to collect; poor cleanliness.

In sprinklered properties the kilns are usually also equipped, but the value of such protection is very questionable. The obstruction offered to the distribution of water is so pronounced that sprinklers could be expected to do no more than hold a fire somewhat in check. Steam jets are used to some extent, and if properly designed a system of steam jets should be of very great value in combatting a dry kiln fire. Such jets should be controlled by a manually operated valve accessibly located outside the kiln.

The principal hazard in connection with woodworking machines is the disposal of the dust and shavings. This is true of all woodworking machines, except the sanding machines, which possess an additional

SPARK HAZARD

in which there is the liability of setting fire to the very fine dust produced by such machines by a spark caused by striking a nail in the piece being worked, or by undue friction.

In practically all modern woodworking plants the method used to remove shavings, etc., from machines is by blower system. This consists of a system of metal pipes which pick up the dust and shavings from the machines. These pipes converge into a large trunk line of pipe, in which is located a fan that draws the shavings from the machines and discharges them to the shavings vault or furnace fires.

TO COLLECT THE SHAVINGS,

and at the same time prevent back pressure on the fan a device termed the "Cyclone" is used. This is usually in the form of an inverted cone, in which the main blower pipes terminate. These discharge into the Cyclone in nozzle form to give velocity to the air stream, and the design is such as to give the air current a spiral motion downward. The effect is similar to that of a cream separator, the air losing velocity and being discharged from the top of the Cyclone at nearly atmospheric pressure, while the dust and shavings pass out of the lower end of the Cyclone by gravity to either the shavings vault or furnace fire as may be desired.

The fire percentage for shavings vaults is 17 per cent., and results from conditions which could be largely remedied.

In the portions of a plant where hand woodworking is done the hazards are comparatively light and consist mainly of arrangement of glue pots, small dry boxes and care of shavings and refuse.

Glue pots should be steam heated and due precautions taken to keep the steam pipes clear of woodwork or other inflammable material. Caul boxes, which are used to dry glued work, veneers, etc., are small enclosures usually of light frame construction and heated by steam pipes.

The hazard here is from improper arrangement of steam pipes.

The disposal of sweepings and refuse is an important item in these portions of the plant. This should be done either through a non-combustible chute on outside of building, or by feeding to blower trunk by hand.

THE FINISHING PROCESSES

in various lines of woodworking vary greatly from the standpoint of hazard. In high grade work the painting and varnishing is practically all brush work, using a good grade of material. In the manufacture of cheap work, as chairs, cheap furniture, parts of machinery, etc., the dipping process is used, usually with benzine as a thinner, making such process quite economical, although very hazardous. Dip tanks should be equipped with automatic covers, have large area overflow and drain pipes leading outside the building, and care taken that the best possible cleanliness be maintained around such tanks.

The rubbing materials, as oily rags and waste, etc., offer the spontaneous combustion hazard when not properly cared for. Standard metal receptacles should be used to hold such materials, and these should be emptied every night and the waste, etc., burned.

In the packing rooms of some plants large quantities of excelsior, paper, etc., are used and this should, if possible, be stored

in some place away from the packing room. Metal or metal lined bins should be provided for loose packing materials.

In a great many plants one of the most important points from the hazard standpoint is in the storage of finished stock. Highly finished stock must be protected from damage by handling and kept free from dirt. This is often accomplished by wrapping in excelsior and paper. In many instances it is necessary to store large quantities of stock wrapped in this manner.

We then have a large quantity of a very inflammable and valuable stock, usually piled as high as possible and very congested. This condition is frequently found in casket factories, and furniture factories of all kinds. Large hollow piles are thus formed that offer every facility to the spread of fire while giving at the same time a maximum obstruction to the distribution of water from sprinklers or hose lines. The remedy is hard to attain in practice.

If at all practicable the stock should be piled with ample head room and with aisles of sufficient width running both ways through room and along all walls.

In a last analysis, however, after carefully reviewing the hazards of what is necessarily a more or less hazardous business, what is most essential is cleanliness and good methods of housekeeping. These cover a multitude of sins in the way of construction and lack of equipment.

TOY MANUFACTURE.

Factories Grouped and Classified; With Suggestions for Ideal Arrangement—Processes and Hazards Described.

By Fredrick L. Green, Assistant Secretary and Chief Inspector New York Office Starkweather & Shepley, Inc.

This is a class of risk least known to the average inspector, and very often the mere suggestion of a toy plant causes the underwriter or the examiner to label it as prohibited. An inspection of fifteen such factories shows at once that they should not all be put in a single class, as the hazards are not all of the same nature, and companies writing foundries or iron workers can safely embrace certain branches of toy factories in their classification.

CLASSES.

As a rough outline of the various classes embodied in the manufacture of toys let us note the following:

Plant No. 1. Sleds and lawn furniture.

Plant No. 2. Wooden toys, not painted or varnished.

Plant No. 3. Rattan furniture, doll carriages.

Plant No. 4. Same as above, with the addition of metal and wooden toys.

Plants Nos. 5 and 6. Tin toys.

Plants Nos. 7, 8 and 9. Iron toys—not colored.

Plants Nos. 10 and 11. Iron toys, japanning, enameling and manufacture of small kitchen utensils for practical use; also garden tools and velocipedes.

Plants Nos. 12, 13 and 14. Wooden toys, rocking horses, wagons and doll houses.

Plant No. 15. Bells, including dumbbells, sleigh bells, toy harness bells and gongs.

It will therefore be seen that we have in a limited number of the class three distinct hazards, viz.:

Nos. 1, 2, 3, 4, 11, 12, 13 and 14. Woodworkers with painting.

Nos. 5, 6 10 and 15. Metal workers and tinners with japanning, dipping, enameling and nickel plating.

Nos. 7, 8 and 9. Iron toys. Foundry work only.

In the woodworking class we have the converting of the rough timber into completed parts ready for assembling. Incidental with this preparation the use of the hot air dry kiln and the

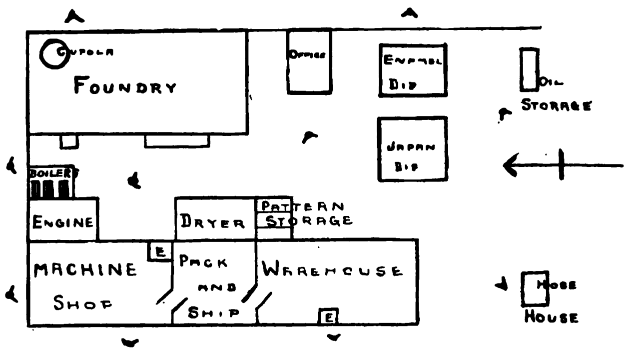
steam kiln are necessary—and in this same class, but in separate plants, we find the full process of upholstering.

In the iron toy class we have two divisions, one with the full foundry process, i. e., converting scrap iron into molten metal with casting, polishing, grinding and tumbling; and in the same class you will note the additional hazard, such as nickel plating, japanning and enameling.

CONSTRUCTION OF BUILDINGS.

In the fifteen plants under consideration we find various types of construction, from semi-mill to frame, including good brick and part concrete.

The tendency of the plant owner is to build a good brick factory, and as additions are required to build these of frame.



PLAT OF MODEL TOY FACTORY PLANT.

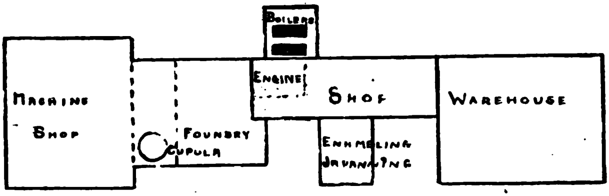
Here we have what might be termed a model brick factory for the manufacture of iron and tin toys with all the hazards of japanning, dipping and enameling, the hazards being segregated. Here the japanning and enameling are done in separate buildings, the distance between the structures and the nearest building is 25 feet, with blank walls on west of japanning building, and 3 feet parapet walls on these two buildings and large thin glass roof skylights, thereby giving the flames an opportunity to shoot through the roof and thus prevent the spread of fire. You will also note that the boiler and engine rooms are separate; no communication, likewise the drying room and the pattern storage. The complex being of minor hazards—machine shop, packing, shipping and warehouse in three sections cut off by approved double fire doors. The foundry is of good brick construction,

BAND SAW USED IN TOY FACTORIES—NOTE GUARDS PROVIDED FOR ALL DANGEROUS PARTS.

with cupola and stack properly protected and loading floor built in standard manner. This plant was laid out by an insurance engineer in order to obtain the lowest possible rate and with the proper allowances for watchman and clock, pails, standpipe and

hose, yard hydrants and steam jets in japanning ovens and enameling shop. Such a plant, in a protected city, would pay an average rate of 87 cents, made up from assured's figures as to value. This same plant, containing the same hazards with the japanning and enameling hazard—in the main complex, with no cut offs and with boiler and engine room communicating and with the protection of watchman and clock, rated under above conditions would produce an average rate of 1,911, thus showing the value of the insurance engineer's ideas and experience.

We come now to a plant of similar hazard, but of frame construcure with no cut-offs and no division walls and no public or private protection:



PLAT OF UNAPPROVED TOY FACTORY PLANT.

Such a factory would rate at 3½ per cent. But with the boiler house built of brick and with no direct communication and the enameling and japanning building removed at least 50 feet, such a risk would not pay over 2 per cent. to 2½ per cent.

HAZARDS.

The hazard of the wooden toy factory is primarily much the same as that of any woodworker, added to which are the hazards of painting, varnishing and upholstering. The woodworking hazard can be safely guarded through the introduction of a blower system; the dry kiln to be a detached building or built of absolute fireproof material, in which case it can be adjoining.

The painting, varnishing and drying hazards are the worst to overcome. This work is generally carried on in the main factory and is automatically done in a number of plants; the parts to be treated are placed on endless racks, carried through the dipping tanks and thence to the dryer, and the drippings are allowed to accumulate under the conveyor; also the painting is done by labor inexperienced in the handling of volatile substances.

The hazard of the upholstery department is the same in a toy factory as is found in any carriage building shop.

The hazard of the iron toy has been mentioned as being that of the foundry.

Then we still have the iron and tin toys with the full process of nickel plating, dipping, enameling, painting and varnishing. Segregation is the best means for cutting down these hazards. In the tin toy factories the tinkers' furnaces must be properly set.

PROTECTION.

Standard automatic sprinkler equipment is the best possible means of leveling all the hazards of these classes, and if all rate-making associations would grant an attractive percentage allow-

CIRCULAR SAW USED IN TOY FACTORIES, GUARDED.

ance in the rate for this outlay there is no doubt that we would find more factories so equipped. In the group of plants now under consideration only three are thus protected, and these buildings are in three different States and come under rates and rules of three different rating boards. The allowances likewise are made in three different ways.

Next to sprinkler protection comes a highly essential feature, that of good housekeeping. This, together with the proper installation of cans for oily waste and common refuse, fire pails

of an equal number filled with sand or water, and a good supply of chemical extinguishers, with a watchman using an approved clock form a decided protection. The New England Insurance Exchange has made it possible to get the factory owner to install this protection in foundries and machine shops, or, generally speaking, all metal workers as a class by modifying their rules regarding the patrol of the watchman, and in this group of factories four watchmen have been put to work since the modification.

BUZZ PLANER.

Too much thought cannot be given to construction and protection when you read that the actual fire loss of the United States and Canada exceeds $250,000,000 a year, which means an average cost to every man, woman or child in the United States and Canada of about $2.25 a year, whereas in Europe the cost is about 30 cents, the German for his part paying about 19 cents.

It has been stated that the insurance of a New England cotton mill, "picker room" and all, can be had for half the cost of that paid by the millionaires of Newport—and why? Fire protection and fire prevention!

SHINGLE MILLS.

Processes and Hazards of This Class of Risk—Moral Hazards—Suggestions for Ratings—Deductions.

Address by Frank L. Emerick, Seattle, Special Agent for the Fireman's Fund, Before Fire Underwriters' Association of the Pacific.

The subject of this paper relates to a class of risks of the utmost importance to companies operating in the Pacific Northwest; it includes the most hazardous risks with which we have to deal. It deserves our most careful attention. I do not expect to enlighten the members of our association whose duties call them to survey this class of risk, but rather seek to convey to those gentlemen who have no opportunity of seeing for themselves some of the processes carried on and the attendant hazard.

There are in the neighborhood of 400 shingle mills within the boundary of that part of the State of Washington west of the Cascade Range, comprising the great timber belt, Snohomish County, leading with more than one-fourth of the entire number, Whatcom County being a close second.

THE SHINGLE INDUSTRY IS CARRIED ON

in two classes of mills, the "wet log" and the "dry log," dependent on whether the logs or bolts are kept stored in the water or whether they are sawed direct from logs or bolts which have not passed through the water. However, a strong distinction should be drawn between the hazard of mills that cut and allow its logs to lie for a season in the woods before they put them through a mill, and those that work up green logs. A like distinction should be drawn between the mills that cut logs which have been in the water for a considerable time and the mill that is working on logs dumped into a small pond of about 20x150 feet, wherein the water is sometimes too shallow to float the larger logs, and in which the logs and bolts lie only a short period of time. In such case the pond is only an excuse to secure the credit in rate of a wet log shingle mill. It is a rank fallacy, as to be a real wet log mill and to eliminate the hazard of dry dust the logs must have been floating in the water long enough to have become saturated. Therefore, the fact that a plant is called "wet log" does not always mean that it is a more desirable risk than a "dry log" mill. To the writer the ideal "wet log" shingle mill is the plant located on tidewater, where logs can be had in

the open market, or situate along a body of fresh water, where logs and bolts floating down from many a streamlet are gathered, or where the railroad company can dump logs or bolts, thus gaining access to a large territory with inexhaustible supply.

A dry log plant, with perhaps a small artificial pond supplied with water from a small brooklet or through a pump, thereby gaining the name of a wet log shingle mill, usually indicates a small plant, cheaply constructed, located far away from transportation, a limited supply of timber belonging to the mill man or possibly to a small rancher in the vicinity. Frequently the supply consists of cedar stumps left by the loggers some years ago at a time when they were rather extravagant and cut the trees some 6 to 10 feet above the ground. It is true that these stumps cut into bolts make very desirable shingle material, but the plant is not a desirable risk on account of its scant supply.

PROCESS.

If logs are used for timber they are drawn into the mill in like manner as at a saw mill, where they are sawed and split into blocks similar to those made from bolts. Bolts, by the way, are simply 4-foot lengths cut from trees and split into quarters for convenience in hauling. They are hauled by wagon or sled from the woods to the mill or floated down a small shallow stream.

The "upright," "double block" and "ten block" comprise the several types of

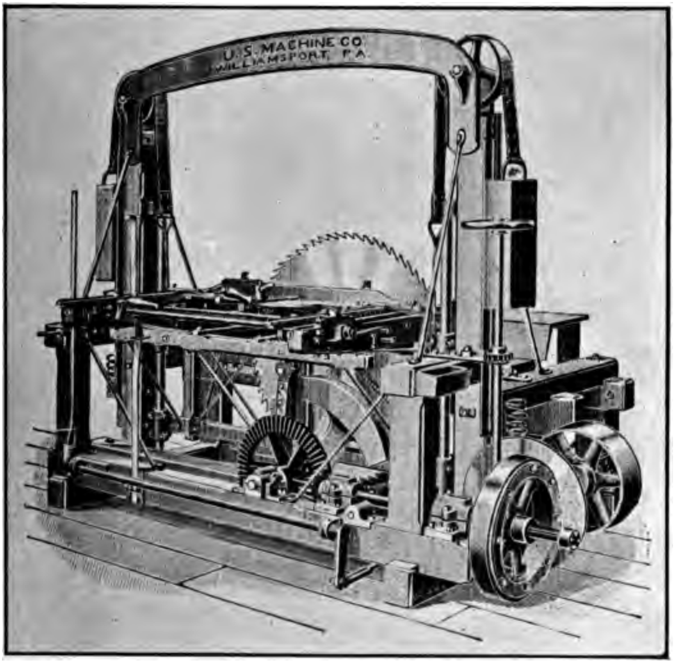
SHINGLE MACHINES.

The first named is the most popular. The process is slower, but the result better than if made in any other manner. In this type the saw travels vertically, only one block being in the machine at a time. The sawyer feeds the machine and also joints the shingle in a circular rotary plane. From the machine the shingles drop to a lower floor, where they are packed into bundles of 250 shingles, then piled on trucks and run into the kiln, where they are dried either by hot blast, that is hot air being fanned into the kiln (the process is obsolete now), or steam heat. For drying heavy green timber it takes in the neighborhood of fourteen days at an average temperature of 170 degrees for best results and for dead dry timber it takes about one-half that time.

THE MORAL HAZARD IS THE MOST IMPORTANT PART

in accepting a shingle mill risk. No doubt it has caused a large percentage of losses in recent years. The fact that a plant is making money for its owner is the very best protection. He is prosperous, has his machinery in shipshape order, takes every precaution, stands watching day and night, as it were, with a pail of water in his hand, has the best watchman money can hire, one

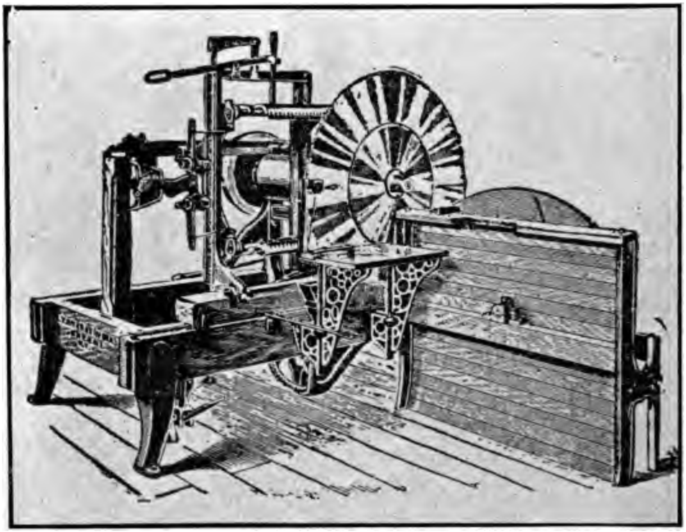
that is strong and active, of good judgment and capable of quick action in case of emergency. The very best judgment is often required to know when to stop and fight the fire and when to run and give alarm; these qualifications and duties seem a great deal to expect of a man occupying a humble position of watchman, but it should be borne in mind that in most plants thousands



IMPROVED FRICTION-FEED SHINGLE SAWING MACHINE.

of dollars of property are in the watchman's sole charge for a large portion of the time. It is false economy to try and save a few dollars by hiring cheap and inefficient men for such service; too often the plant is left to the watchman whose only qualification is that he will work for small pay or he is an old employee who is long past his years of usefulness, or he is a

cripple who is not able to do hard work, or he is an ignorant foreigner who has not been in this country long enough to know English. Not that the mill owner would intentionally cause the plant to burn, but many have all their capital, the earnings of years tied up in the mill and sometimes the plant is heavily mortgaged in addition. When the bottom drops out of the shingle market, he is losing money and feels he cannot afford to pay a competent millwright, but replaces him by a second rate man who is a "jack of all trades," allows the line shafts to get out of align-



SHINGLE AND HEADING MILL.

ment, the machinery is kept in poor condition, possibly running too fast and hot boxes are the result. To cut expenses further, the night fireman is merged into night watchman and clean-up man. It is impossible to serve two masters; if he cleans the mill as it should be, the fire box must be neglected. With the Dutch oven the hazard is still greater.

WE SELDOM FIND A RETAINING WALL,

or a bin for refuse. There is always danger of the fire crawling from the opening in the oven to the pile of cedar dust. On the

other hand, if the cleaning up is slighted, the dust hazard through the mill is greatly increased, and with the increased danger of the hot box occasioned by the absence of a competent millwright, a complication of hazards is set up. And again, possibly the timber supply is exhausted, and it is cheaper to sell the mill to the insurance company for possibly 50 per cent. of the original cost, depreciation being very heavy on machinery of this type, than it is to move the plant to new timber. Such conditions have existed for the past four or five years. There are now signs of more satisfactory conditions. The shingle market which has been starved for some time is picking up. On the other hand, desirable timber locations are becoming more scarce. Fewer mills are being built, and those that are, I believe are more nearly up to standard. The educational work of the surveyor's office by charges for shortcomings and credits for betterments, has had its beneficial effect. More frequently the lumberman contemplating building, now gets in touch with the surveyor's office to the end that the mill may get a rating as low as possible.

PHYSICAL HAZARD.

We, of course, have in mind the construction of the standard mill, but let us go behind the scenes and look up the real condition. A very small percentage of shingle mills, as compared with lumber mills, are built up to standard. There are exceptions, however, but the average mill is rather cheaply constructed, often on piles over tide flats.

Blower systems are rarely known in shingle mills, and for that reason the accumulation of dust is more abundant than in other classes of mill risks. I only know of one shingle mill located at Anscortes, which has a blower system installed. Shingle dust is a great conductor of fire. It is even dangerous to direct a small stream of water into a pile of burning cedar dust; the burning particles will float on the water like so much oil and has a tendency to explode. A fire that cannot be extinguished with a few pails of water, may as well be counted beyond control. Not enough stress is placed on the necessity of barrels of water with pails. The old time experienced mill man will tell you how essential they are.

The boiler is usually located in the main mill building with not as much as a 1 inch frame partition to exclude the stray sparks from either fire box or from cracks in a defective brick boiler jacketing. Too often the steam pump, the only source of water supply, is installed in the boiler room, and at just the time when it is most needed it is out of commission. Oils are frequently kept in the boiler or engine room, with no drip cans to catch the waste oil, but allowed to saturate the floor with an abundance of dry dust collecting.

If it were possible to get the mill men to whitewash the inside of their plants, it would not only give the protection that is usually expected from whitewashing, but would show up the dust more plainly, and suggest to the mill owner the necessity of keeping swept down. The indifference in the care of used cotton waste is simply dreadful.

A standard refuse burner is too expensive for the average small shingle mill, therefore the open slab fire is much in evidence, and this is another reason why the watchman should be on the job all the time.

THE DRY KILN.

I think too much emphasis is attached to the construction of the kiln, and that not enough attention has been paid by insur-

DRY KILN.

ance men to prevent overheating. There are various causes of fire in kilns, but I believe that the usual cause is overheating. Experiments have been carried on by certain mill men, and Prof. H. K. Benson, who holds the chair of Industrial Chemistry at the University of Washington, which go to show conclusively that many dry kilns destroyed by fire, supposed to be of incendiary or other origin, have been due to spontaneous combustion. In endeavoring to determine what products can be obtained from wood for commercial advantages, it was found that when cedar was subjected to a perfectly safe temperature for a

sufficient length of time to entirely remove the moisture from the wood, it immediately began to absorb heat and to form certain dangerous gases.

The cedar is filled with thousands of cells. At the time the timber is cut these cells are filled with air and water. The drying process causes evaporation, leaving air spaces in each section of wood, and reduces the fibre to a very thin substance almost like tinder, therefore the excessive heat causes a charring of the shingles. If this is not checked the shingles are likely to burst into flame.

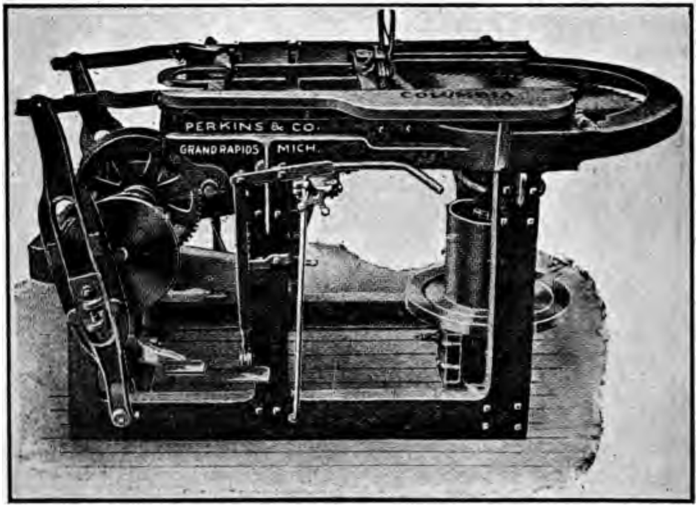
THE CAUSE OF OVERHEATING

is due largely to the present system of marketing the product. Shingles are sold by the thousand, and it is to the advantage of the shipper to have them weigh as little as possible. If they weigh less than the customary weight the difference in freight is just so much profit to the manufacturer. This leads, naturally, to forcing the kilns to obtain what are called "underweights." If there is no legitimate profit the manufacturer just makes his margin on underweights. This temptation is removed when the product is shipped by water and would be removed in all cases if railroad companies would base their freight charges on so much per thousand shingles, instead of the actual weight. Fires in kilns of lumber mills are infrequent as compared with those in shingle kilns. A temperature of 180 degrees is not dangerous. Old time mill men tell me that when the temperature reaches 200 degrees the control is gone, and the heat is likely to jump as much as 25 or 30 degrees in a few seconds.

KILN CONSTRUCTION.

Of course it is understood that a brick, concrete, or crib construction kiln is safer, but from the standpoint of salvage it has no advantage over the cheaply constructed kiln. Usually the insured carries what we might call only accident insurance, just enough to cover as near as he can figure to repair the brick or concrete kiln. It is generally understood that steam pipes should be well away from the wood, that there should be a dirt floor, kiln whitewashed inside, a flat roof with no concealed spaces underneath. Frequently not enough attention is given to admission of air at hot end of the kiln, and ventilating stacks at wet end, for the purpose of securing a draft, keeping up the circulation, and eliminating the hot dead air. Dampers in the ventilators should be closed in case of fire in the kiln. Some mill men make fun of the idea of live steam jets; nevertheless, it has been proven to my satisfaction that they have been instrumental in smothering out fire if the draft is shut off. The thermometer, as usually installed, is of very little use because it is put near the middle of the kiln, separated from the outside air by a light

pane of glass or a thin shingle. It should be in the hot portion of the kiln, i. e., near the roof at the dry end, where it will get the full blast of the heat. Perforated pipe sprinklers to flood the kiln have proven to work successfully along with live steam. In case of fire in the kiln, turn on the live steam, together with the sprinkler, shut off the drafts, keep the doors closed, insert a stream of water through the portholes on the side of the kiln near the top. Many an old dilapidated looking kiln will stand



SHINGLE SAWING MACHINE.

where the supposed up to date brick kiln will fall before the ravages of fire.

So far as I am able to find the record of fires is held by two up to date equipped plants with brick kilns. Each has burned three times. The secret is simply this: The old dilapidated kiln is so far from air tight that it is impossible to get the temperature above 150 degrees to 160 degrees.

It is assumed that shingle mills have been as a class unprofitable. However, I am of the opinion that if companies which *write freely on* shingle mills segregate the class, and do not in-

clude lumber mills of various kinds, it could be shown that shingle mills do not reduce the average.

SCHEDULE FOR RATING OF SHINGLE MILLS AND DRY KILNS.

The rates arrived at in the Pacific Northwest through the use of the following schedule put the shingle mill business in a very different light as compared with the rates that existed in Northern Wisconsin and other sections of the Northwest, when shingle mills were a prominent industry there:

SCHEDULE FOR SHINGLE MILLS.

Basis		4.00
A.	Construction—Standard—Fair	.18
	Cheap	.35
B.	Faults of Management or Conditions—Untidy, etc	.35
C.	Shingle Roof	.35
D.	Shingle Roof—With Barrels of Water and Metal Fire Pails or Open Sprinkler System	.18
E.	If Not Whitewashed Inside or Painted With Fire Retarding Paint	.16
F.	Using Dry Logs on Bolts	.70
G.	Oil Room in Mill or Within 40 Feet	.10
H.	No Watchman	.18
I.	Watchman Without Approved Watch Clock	.10
J.	No Fire Pump, Hydrants and Hose	.70
K.	Without City Fire Protection or Water Tank	.70
L.	Without Water Barrels and Metal Fire Pails Inside of Each Floor	.18
M.	Without Ladders to Roof	.10
N.	Open Lights	.35
O.	Boilers in Main Building or Within Loft	.70
P.	Brick, Crib or Ironclad Boiler Houses—Follow Saw Mill Schedule	
Q.	Metal Stack Without Spark Arrester Over Wooden Roof	.35
R.	Metal Stack Less Than 30 Feet Above Highest Point of Mill	.18
S.	Stove Pipe	.35
T.	Artificial Stone, Cement or Terra Cotta Chimney	.10
U.	Refuse or Slab Fire, Within 100 Feet	1.40
U.	Refuse or Slab Fire, Over 100 Feet, and Within 150 Feet	1.05
U.	Refuse or Slab Fire, Over 150 Feet, and Within 200 Feet	.70
U.	Refuse or Slab Fire, Over 200 Feet, and Within 300 Feet	.35
V.	Exposures—Apply Schedule or Tariff as Provided	

W. Dry Kiln Exposure—Follow Schedule Percentages of Dry Kiln Deficiencies $4.20

Within 20 feet, charge 50 per cent.; 20 to 40 feet, charge 40 per cent.; 40 to 60 feet, charge 30 per cent.; 60 to 80 feet, charge 20 per cent.; 80 to 100 feet, charge 17½ per cent.; 100 to 120 feet, charge 15 per cent.; 120 to 140 feet, charge 12½ per cent.; 140 to 160 feet, charge 10 per cent.; 160 to 200 feet, charge 5 per cent.

DEDUCTIONS.

Approved automatic sprinkler system, with 70 per cent. co-insurance clause, 2 water supply, 50 per cent.; 1 water supply 25 per cent.

SCHEDULE FOR SHINGLE DRY KILNS.

Basis		6.00
A.	Standard—Cheap—Fair	.70
B.	Wooden Floor	.35
C.	Shingle Roof	.35
D.	No Perforated Pipes on Roof and Inside	.70
E.	No Steam Jet in Kiln	.35
F.	Steam Pipes on Wood Supports or on Iron Supports, Within 2 Inches of Wood	.70
G.	Hot Air Blast	1.40
H.	No Fire Pump, Hydrants and Hose	.70
I.	Without City Protection or Water Tank	.70
J.	No Watchman, Night, Sundays, and When Works Not in Operation	.18
K.	Watchman, but Without Watch Clock in Use	.10
L.	No Thermometer	.18
M.	Refuse or Slab Fire, 200 to 300 Feet	.35
M.	Refuse or Slab Fire, 150 to 200 Feet	.70
M.	Refuse or Slab Fire, 100 to 150 Feet	1.05
M.	Refuse or Slab Fire, Within 100 Feet	1.40
N.	Exposures—Apply Schedule or Tariff as Provided	
O.	Mill Exposure—Follow Schedule Percentages of Mill Deficiencies	$2.80

Within 20 feet, charge 50 per cent.; 20 to 40 feet, charge 40 per cent.;40 to 60 feet, charge 30 per cent.; 60 to 80 feet, charge 20 per cent.; 80 to 100 feet, charge 17½ per cent.; 100 to 120 feet, charge 15 per cent.; 120 to 140 feet, charge 12½ per cent.; 140 to 160 feet, charge 10 per cent.; 160 to 200 feet, charge 5 per cent.

DEDUCTIONS.

Approved automatic sprinkler system, with 70 per cent. co-insurance clause, 2 water supply, 50 per cent.; 1 water supply, 25 per cent.

I believe a more severe penalty should be exacted for the lack of a competent watchman, the absence of barrels of water with

fire pails, together with a thermometer that registers the exact temperature. These may seem rather insignificant, but not so when we consider that the pilot of the boat, and the engineer of the train are ever at their posts; they know that the machinery must be in ship-shape order, that their steam must be right, or the worst is likely to happen. If the same care would be applied in the case of the shingle mill the hazard would naturally be reduced.

THE COOPERAGE INDUSTRY.

The Art of Barrel Making One of Great Antiquity—History—Processes and Hazards Described.

By J. Albert Robinson, Superintendent of Fire Records, National Fire Protection Association, Boston, Mass.

The art of the cooper is doubtless of great antiquity. Pliny ascribes the invention of casks to the people who lived at the foot of the Alps. In his time they lined them with pitch. Varro and Columella, previous to the time of Tiberius and Vespasian, at the beginning of the Christian era, in detailing the precepts of rural economy, speak distinctly of vessels formed of different pieces and bound together with circles of wood, or hoops. The description which they have given accords exactly with the construction of casks. In very early days in England the "good men of the mystery of coopers" had banded themselves into a Master Coopers' Guild. Few people realize what a large business the manufacture of the ordinary barrel has become, and what an important part it plays in many other industries. The lowly barrel is one of the great necessities of commerce. The full process cooperage plants have now mostly passed away from the East, especially those using hardwood, and are found in the timbered sections of the North and West.

THERE ARE TWO DISTINCT BRANCHES of the cooperage industry, one manufacturing "slack barrels" and the other "tight barrels." Although the processes and hazards are quite similar, the raw stock is quite different and both kinds of barrels are rarely manufactured at one plant. The "slack" barrel is so designated from the fact that it is only used to hold commodities which are not in liquid form. Flour and sugar barrels represent the highest grade manufactured. Cement, lime and salt barrels come next. Inferior grades are those barrels which are known as truck barrels, used for fruit and vegetables, and the barrels and kegs used in the crockery, glassware and hardware trades. "Tight" barrels are those that are designed to hold liquid commodities, beer, wine and liquor barrels being the best type of this class. Pork, vinegar, paint and oil barrels are also common examples. The tight barrel plant, owing to the nature of its stock, is somewhat less hazardous than the slack barrel factory.

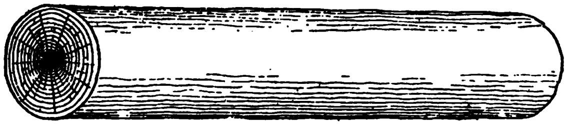
Many cooperage plants are not full process and the barrels are not made complete from the raw stock but merely assembled and finished, the raw stock, consisting of staves, heads and hoops, being made in factories specializing in these products only. Some factories manufacture staves only, others headings only, while some manufacture staves and headings. There are some that manufacture staves in connection with a hoop mill. The manufacturing of hoops is quite a specialized industry, but may be found in many full process plants. This work was formerly largely done by individual hoop makers in a back shed on the farm, and in certain territories today large quantities of hand-shaved hoops are made by farmers or local coopers. Iron and steel bands and wires are rapidly coming into use, especially in the manufacture of slack barrels. Manufacturers of the latter have heretofore resisted this innovation, but probably in the future most slack barrels will be bound in part at least in this manner. Metal hoops have long been used in the manufacture of tight barrels. Many cooperage plants, especially where not full process, manufacture a side line of kegs, tubs, crate stock, trunk strips and dimension stock, such as chair rungs, posts, seat frames and numerous other articles in general use.

RAW MATERIAL.

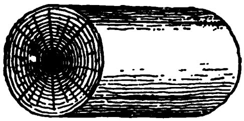
On account of its great strength and toughness, elm has long been the principal and favorite wood used for slack barrel staves and heads. Red gum is rapidly coming into favor and is undoubtedly destined to be the future wood used for this purpose. Oak is the most common wood employed in the manufacture of tight barrels. The principal wood used in the manufacture of hoops is elm; red gum, ash, hickory and birch are also used to some extent. The steel mills furnish an increasing amount of hoop bands and wires for this purpose.

THE BOLTING ROOM

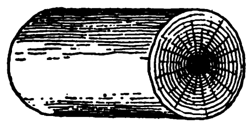
is where the timber is sawed into the proper lengths for cutting into staves, heading or hoops. The logs are generally brought into this department from the log pond on an inclined log trough by means of an endless chain log jacker or log haul-up, and landed on the sorting deck where they can be properly inspected and put to the uses for which they are best adapted, the better grade of logs going into hoops or staves and the more inferior ones put aside for headings. Some mills use a steam kicker or a log unloader for throwing logs out of the log trough in the mill. The logs are then taken to the cut-off saw, which may be a "drag saw" or a "drop circular saw." "Steam dogs" are used for holding the logs firm and in position while being sawed, and may be of the overhead type or floor level type.



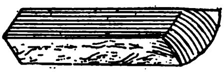
Shows the log as cut from tree.



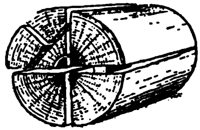
Shows manner of splitting timber into stave bolts where timber is of small diameter.



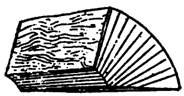
Shows section of log as cut 3 feet long, for stave bolt.



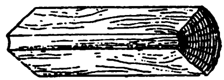
Shows manner of sawing staves upon a cylinder stave machine.



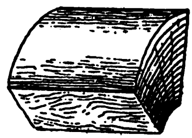
Shows manner of splitting section for timber of large diameter into stave bolts. In making staves, as well as heading bolts, for oil and other tight work, it is ever and always necessary to keep with the grain of wood.



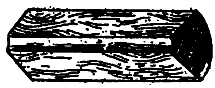
Shows manner of sawing pieces of heading from Bolt by the Head Sawing Machine. They are cut 1 inch thick upon sap, ¾-inch thick at the heart, 24 inches long. Two or three pieces are required to form a complete head.



Bolt cut to uniform length on Bolt Equalizer ready for cylinder stave sawing machine.



Shows heading prepared from tree same as in stave bolt.



Stave bolt quartered and heart split off.

The blocks as they come from the drop or drag saw are then passed to the bolting saws where they are cut into short pieces or bolts, the proper length for the staves or headings. The bolts are then sawed into quarters, a process known as quartering, so as to allow keeping with the grain when cutting into staves. These quarters, or bolts, are further split into flitches, or stave bolts, a process known as bolting or flitching. The illustrations on the preceding page show these various conditions.

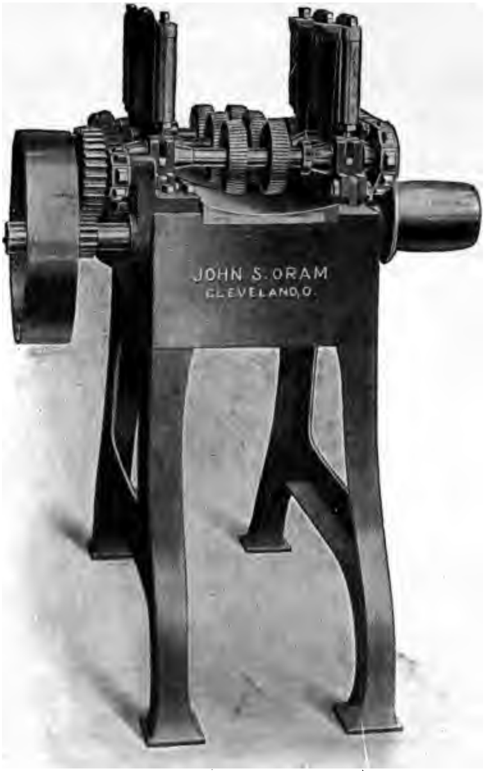
STEAM BOXES FOR STAVE BOLTS.

The principal object to be obtained in steaming the wood before cutting is to extract or force as much of the sap out of the timber as possible, at the same time making the fibres of the wood soft and pliable so that it will shear or cut easily and dry quickly after being cut, in order to lessen the possibilities of the staves molding. For some woods a longer time, less heat, or lower pressure, and more moisture is advisable. A combination of live and exhaust steam is frequently used. There are different types of steam boxes in use, and the tendency is, where new plants are constructed, to make them of concrete, which is no doubt the most satisfactory method from the operative point of view, and far to be preferred from the fire hazard point of view. Where steam boxes are constructed of wood, it is often necessary to rebuild them as often as once every two or three years. After the stave bolts have been properly steamed and barked they are taken to the bolt equalizer, which cuts the bolts to proper lengths for staves.

THERE ARE SEVERAL METHODS OF MAKING STAVES.

Knife cut staves are made by the steam-box and knife chopper. These staves are said to be satisfactory for barrels only when made from large fine elm timber which has been properly steamed, cut and jointed. Veneer staves are made by cutting sections of logs into stave lengths; boiling in vats of hot water; then passing through a rotary veneer lathe, which turns off a veneer about three-eighths inches thick, and a clipper cuts the staves from the sheet. This process is largely now impracticable by reason of the fact the timber suitable is too valuable for the purpose. Slat staves may be cut with single or multiple circular saws, and saw mill slabs can be utilized for the purpose. This process is little used, however. For manufacturing slack staves from soft woods, the cylinder or drum saw is being most generally adopted in this country today. Some tight barrel factories use regular quartered oak strips. At this point the staves may be air seasoned or put directly into dry skins. This is described later.

to produce a finish and uniform thickness and are passed to the jointer. This is a rotary steel wheel, having huge discs that travel



STAVE PLANER.

at a high speed. The faces of the discs are provided with knives supported by caps, and their faces are turned to give the staves necessary bilge and bevel. The last operation consists of crozing,

chamfering and equalizing, both ends at one operation, upon an automatic crozer, this completing the finished stave. This last operation may be omitted at this point and done in the cooper shop, after the barrels have been set up. Unless previously sufficiently dried the staves are then sent to the dry kilns. In factories which manufacture staves only, it is necessary to pack the staves into bundles subsequent to shipping, and for this purpose a stave press is used. In the use of this machine the staves are packed alternately, wide and narrow ones, and so arranged that each and every bundle will contain as nearly 200 inches as possible; this is figured as fifty staves, averaging 4 inches per stave to each bundle, and is the standard method of packing.

THE PROCESS OF "BOLTING OUT"

or preparing heading bolts is accomplished in a manner similar to that of making staves. When the heading bolt has been properly prepared, it is taken to the heading saw. This may be of the upright or pendulous swing type, or the horizontal hand feed type. The heading blanks being thoroughly air-dried or kiln-dried, as the case may be, and then thoroughly acclimated, are brought to the heading room for finishing and turning. Here they pass through the heading planer and then the heading jointer, which may be either a wheel jointer or a saw jointer. After the heading pieces or blanks have been properly jointed, they are matched, or the pieces assembled for the size head to be turned. Care is taken, in matching up the head blanks, that the narrow pieces are placed in the centre of the head and the wider ones on the "cant," as small, narrow cants are extremely difficult to hold in the bundle and also more or less difficult to put into the barrel. It is generally the rule to assemble these heading pieces in piles up to a convenient height on a bench or short skid, and as the operator on the heading turner finishes one pile, the next one is shoved up to within easy reach.

The heading turners are designed for circling all sizes of heading or square-edge covers, and are almost automatic in their operation. Aside from placing the heading blanks in between the clamps, all that is required of the operator is to tread upon a foot lever, and by this one operation the heading pieces are clamped, then immediately brought in contact with the saw and the machine put in motion. When the head has been turned, the machine throws itself out of gear, discharges the finished head, and is in position to receive another. The operator, having no need to touch the machine with his hands, can have the next head ready to drop into the machine the moment the finished one has been discharged. The heading turners are also equipped with a chamfering saw which turns the outside bevel on the head. This is a very important feature, for if the bevel on slack heading is

LEVELING MACHINE.

too sharp and put into the package "stiff" it has a tendency to cut into and weaken the chime; and if the bevel be made too blunt, it does not enter the croze properly, and the head is liable to fall out, should the package receive a sharp, sudden jolt. After the heading has been properly turned, it is packed in bundles and bound with wire or flat steel bands, in a heading packer if the complete barrel is not made on the premises.

THE MANUFACTURE OF SLACK BARREL HOOPS.

There are two distinct methods of manufacturing coiled hoops—cutting and sawing. In the former method the timber is sawed into planks at the sawmill of a thickness that will make the width of a hoop, then cross-cut to proper length, after which it is put into a boiling vat and when the wood fibres are properly softened by the hot water the planks are taken to the hoop cutter and sliced by a large knife into thin strips or hoops, and then jointed and lapped. Where sawed hoops are made, the timber is also sawed into planks at the sawmill, but instead of being boiled and cut with a knife, the plank is run through a gang ripsaw, which saws it into bars that are of sufficient thickness or size to split and make two hoops. It requires more timber to make a given amount of sawed hoops than it does to make the same number of cut hoops, because a certain amount of the wood is wasted in sawdust.

A cut hoop plant generally has a hoop cutter—that is, a long heavy knife that cuts the hoop from the plank—a jointer or lapper, a hoop planer and a coiler. For sawed hoops one generally requires a sawing outfit, which consists of a machine that contains both a planer and a jointer or lapper, a self-feeding rip or gang saw for preparing the bars or strips, and a coiler. The hoop coiling machine turns out from 16,000 to 20,000 hoops per day. Hoops must be placed in the coils while they are hot, otherwise the fibres of the wood are strained or entirely broken. It is necessary to pile hoops in yards so that they may become properly seasoned. When properly seasoned, they should be taken in and placed under cover or shipped. The introduction of metal hoops has brought

A NEW HAZARD

into the cooperage industry—that of dipping. A cheap coating liquid is used, which is applied to prevent rusting. It consists principally of benzine with rosin in solution. As these dipping tanks are found in use by those who have not been educated to the use of this hazardous process, the arrangements are apt to be about as bad as possible, and this feature should be carefully looked into by inspectors and engineers in the future. Standard dip tanks and approved arrangements should be insisted upon. The principal hazards of the processes previously described consist in the

HANDLING AND DISPOSING OF THE WASTE.

The total percentage of ultimate waste in manufacturing cooperage stock, even in the best regulated mills, is astonishing. Studies made by the Forestry Service of the United States Department of Agriculture indicate that in the manufacture of staves and hoops, only 50 to 60 per cent. of the contents of the log which goes into the mill finally emerge in the manufactured form, and that with heading perhaps no more than 25 to 30 per cent. of the actual volume of the log finally goes into the finished package. The disposal of this waste is, therefore, a serious and important item.

CONVEYING.

Three methods are in vogue, with numerous variations. These are, first, hand removal, in which shavings and dust are discharged into the open room, swept up by hand and taken to boiler room in wheelbarrows or trucks; second, by chain or belt conveyor discharging to fire pit; third, the well known fan blower system with cyclone separator, which is the method in general use and the only approved method. An effective system requires that all the machines should be connected with it; that the main pipes should be as straight and smooth as possible, without obstructions, which both produce back pressure on the fan and collect dust; that the fan should be as compact as possible in its construction, with both bearings outside and self-oiling; and that there should be efficient cyclone regulation. With a one story woodworking building, the best location for the fan is the basement. It should have an "up discharge" to the roof, over which the main discharge trunk may be run to the shavings vault. The cyclones should be located on the roof of the shavings vault and provided with a screen at the top to prevent sparks from chimneys or exposure dropping into the vault. Automatic cut-offs or dampers in the discharge pipe between the cyclone and fan are not considered generally advisable, as they are unreliable and form an obstruction in the pipe. The fan should always be run for five minutes after the machine room shuts down, to clear the system of dust, in which case there is small liability of a vault fire backing up through the cyclone and discharge pipe and thus getting into the mill.

THE SHAVINGS AND WASTE

are either fed to boiler direct or sent to shavings vaults. These should be constructed and located according to well recognized standards, and protected by properly installed automatic sprinklers and steam jets. Many fires originate in the shavings vaults of cooperage factories. With few exceptions, boiler furnaces are directly or indirectly responsible for these fires. Of causes not originating at boiler furnace or stack, the following may be

noted: Sparks from exposure entering unscreened top of cyclone; oily waste or sawdust being blown through fan to vault and igniting spontaneously; spark originating in the fan from some metallic or hard substance striking the blades; or from long shavings winding about fan shaft and heating from excessive friction, the resulting fire or spark being blown to vault. It is also possible that a fire or spark originating at one of the wood working machines, particularly a sander, may be blown through the fan to shavings vault. When the construction, arrangement and protection of shavings vaults are in accordance with the best known rules, a vault fire ought not, and probably would not, cause serious damage.

DISPOSAL.

The waste and refuse is burned under the boilers, and may be fed into the furnace by hand, or may be drawn in through metal pipes direct from the cyclone. The latter method is the safest and gives better all round results with the ordinary type of boiler furnace. Among the common causes of fire in the boiler room, due to the inherent hazard in the combustion of light materials, are so-called "back drafts" (really smoke vapor and gas explosions inside the furnace) which throw sparks or coal from the furnace into shavings piles and vaults; or in case of poorly arranged furnace feed pipe, the fire may be carried back through this pipe into the shavings vault, or even into the main plant. This danger is eliminated and the disposal, utilization and combustion of large quantities of bulky, light, heat giving fuel greatly facilitated by the use of the so-called Dutch oven, or bulldog furnace.

DUTCH OVEN.

This is simply an extension built in front of the boiler into which the fire grates are placed instead of being put inside of the boiler wall proper, and underneath the front end of the boiler. The details of construction differ, but the general idea is the same in all cases. These ovens are generally built about ten feet long and should be fully as wide, and can very well be wider than the boiler front itself. All kinds of culls, sawdust, bark, etc., can be thrown into them without much effort, making them a labor saver and the most economical furnace for this purpose. In many cooperage plants the sawdust is conveyed direct to the furnace through the blow pipe. It can be dropped in equally as well with a chain conveyor. There should be an extra large opening on top to allow the fireman to shovel or scrape the creeping fires into the furnace from the floor level. The blow pipe, or chain conveyor, should be arranged in such a manner, having an extra leg or side extension with a switch or damper attached, so that when no fuel is wanted directly under the boiler it can be thrown to one side. Under such conditions the

Barrel Steamer.

fuel should not be piled on top of the oven, as fuel frequently ignites here. It is needless to say that platforms of wood, built up to the level of the oven floor, should be protected. This furnace frequently has a rather hazardous appearance and is carelessly operated, yet does not appear to have caused many fires. In fact, such furnaces materially reduce the hazards of waste disposal.

SEASONING AND DRYING.

Seasoning is ordinarily understood to mean drying. When exposed to the sun and air, the water in green wood rapidly evaporates. Seasoning also implies other desirable changes in the wood besides the evaporation of water, the nature of which is not understood. The most effective seasoning is without doubt that obtained by the uniform, slow drying which takes place in properly constructed piles outdoors, under exposure to the winds and the sun and under cover from the rain and snow, and is what is termed "air-seasoning." By air-seasoning oak and similar hardwoods nature performs certain functions that cannot be duplicated by any artificial means. Because of this, woods of this class cannot be successfully kiln-dried green from the saw. Slack barrel staves and heading dry faster than tight barrel stock, from the fact that they are much thinner. Air-drying out of doors takes from two months to a year. After this preliminary seasoning, the heads and staves are kiln-dried. With soft woods it is common practice to kiln dry direct from the saw or knife, but many manufacturers prefer to pile the staves in the yard or under open sheds to season. Open sheds are now considered by the progressive manufacturers as being the most economical and proper method of piling staves for proper seasoning. The sheds are usually about 20 feet wide and 100 to 150 feet long. The seasoning sheds often form serious exposures to the main plant, and where a plant is located near a railroad fires in these sheds are not infrequent, due generally to locomotive sparks. Sheds should be located an ample distance from principal building to prevent forming serious exposures.

NO SPECIAL FORM OF DRY KILN

has developed in the cooperage factory. The usual types may be found. As many plants are old and long established, few are equipped with very modern installations, and serious fires in dry kilns are fairly frequent and generally very disastrous. Dry kilns should preferably be detached from all other buildings and built in the most approved manner. Above all, wood sheathing and hollow wood finish should be removed where present, and if area is large, kiln should be divided into sections by fire walls. Dry kilns should be completely sprinklered and provided with steam jets. A few manufacturers have arranged carbonic acid

"TIGHT" BARREL HOOPER.

gas generators, so that gas may be immediately generated and turned into the kiln in case of fire. Kilns should be so constructed that cleaning out wood dust is an easy matter, and pipes should be so located that all stock can be kept clear of same. Any connecting hot air or blower pipes between dry kilns should be arranged with dampers or other positive cut-offs. In case of fire, all blowers that may be running should be stopped, and all dampers in kiln flues closed. All kiln doors should be tightly closed.

COOPERING.

If the plant is in full process the staves after they come out of the kilns are sorted out into bundles containing the suitable number to complete a barrel, and sent to the cooper shop. If the staves are received from another plant the bundles, which have been previously made, are first put into kilns and redried before going to the cooper shop. In many tight barrel shops the staves are air-dried only. The first process is assembling or "setting up." A "setting up form" is used by the cooper to set up the staves into barrels. The standards on which the quarter hoops rest are adjustable for different sizes of barrels, but the bottom iron ring around which the staves are set has to be of a different diameter for varying sizes of barrels. The upper ring is called a truss hoop. The set up barrel is then taken to a power windlass, where a wire rope loop is dropped over the top of barrel and the staves drawn together and held a moment while the operator drops on a head truss hoop over the end. A clutch loosens the rope by depressing a foot lever, and the rope is drawn out of the way by a weight. The power windlass is not necessary for all types of barrels.

IT IS VERY ESSENTIAL

that the staves be absolutely dry before applying the hoops, in order that the staves shall hold their position and not spread while being headed. The assembled barrel is thereafter put on a barrel heater or criset. and scorched. The fire box is at the base and wood or coal may be used. The heaters are made with an inside corrugated fire-holder, and an outside sheet iron casing. The headless barrels are set over the crisets for a few minutes to heat sufficiently. Frequently the inside of a barrel takes fire, whereupon a workman takes it up and blows out the fire. Sparks are sometimes blown into other combustible material and a fire ensues. These crisets are generally located in a large brick oven hearth or fireplace, the chimney from which produces the required draught in the criset. There are some forms of patented barrel heaters now in use that are far to be preferred. These consist of heaters elevated above the floor with an automatic lifting arrangement, on which the barrel may be placed on the

floor and elevated to the inside of heaters, which are supplied with gas burners. A battery of these heaters may have ventilating pipes connecting with a single trunk line, through which a draft may be secured and the sparks, if any, carried off. In tight barrel factories it is necessary to steam the assembled barrel before it is heated, in order to soften the hard wood.

The barrels then pass to a machine which automatically joins the trusses on more firmly, thus making the barrel tight and ready for the hoops. If the staves have not been previously chamfered and crozed, this is now done, after which the quarter trusses are removed and the hoops placed around the barrel, put on a machine and pressed into place. The barrel is then automatically headed at one end and the end hoops placed in position. Some barrels are sandpapered on belt sanding machines before the hoops are in place. In manufacturing some barrels the heads are glued. Electric heated glue pots are coming into quite general use for this purpose. Many barrels are sized inside, especially tight barrels. This is generally accomplished by using melted paraffine, which is melted in steam jacketed kettles. Hand coopered barrels are considered the best, and most of the large tight barrels, especially those used in the liquor and spirit industries, are so made. Beer barrels and kegs and similar small goods are generally machine coopered. The refuse which accumulates in the coopering room is generally removed by hand.

SAWS AND KNIVES.

Saws do not run or fit themselves, and they require the proper amount of care and attention in order that they may produce a maximum quantity and improved quality of output on a minimum saw kerf. The most successful coopers today consider it good practice and a profitable investment to supply every tool or appliance calculated to facilitate the filer's work. Knives also need much attention. They are sharpened either by hand file, grindstone or emery wheel. Knives are sometimes tempered at the cooper shop. There is nothing in the filing room equipment that offers any hazard.

THE STORAGE OF BUNDLED STAVES

and finished barrels offers an opportunity for stubborn fires and large losses, owing to the large amount of piled inflammable material and obstructions to distribution of water where sprinklers are present. A large salvage may result from staves which have been wet down, as they may be dried in the kilns and used. Where the barrels are wet, they are apt to swell and burst the hoops, thus entailing a considerably greater loss.

CELLULOID DANGERS.

Summary of Results of Series of Tests of Celluloid and "Cellit" Films.

Having regard to the interest taken at the present moment in the provision of suitable substitutes for the dangerous celluloid cinematograph films, which are now not only used in theatres and halls but also in schools and private residences, and even on children's toy lanterns, the British Fire Prevention Committee announce that they have undertaken a series of comparative tests with cinematograph films of celluloid and of a substance known as "Cellit," and that the results of these tests may be summarized as below. The tests demonstrated:

1. That an ordinary celluloid film is extremely inflammable and burns with great rapidity and fierceness.

2. That a loose roll of celluloid film when ignited is most difficult to extinguish with water or sand.

3. That celluloid films present in a building add most seriously to the fire risk.

4. That celluloid films when burning produce a pungent smell and dense suffocating smoke.

5. That a cinematograph film made of "Cellit" is practically a non-inflammable film, and may be described as "non-flaming."

6. That, even if the conditions are such that a loose roll of "Cellit" film should become ignited, the film either burns with difficulty or can be easily put out.

7. That "Cellit" films may be present in large quantities in a building without materially increasing the fire risk.

8. That practically little or no objectionable smoke was produced when "Cellit" films were burnt.

Having regard to the results of these tests "Cellit" has been classified by the committee as "non-flaming." It is the only celluloid substitute that has so far been submitted to the committee for official test and carries its certificate.

IRON GALVANIZING PLANTS.

Description of the Uses of This Product, the Processes Employed in Its Manufacture and the Hazards Attendant Thereto.

By [illegible] *Engineer.*

[illegible] which has been [illegible] The iron is simply [illegible] galvanic process, as its [illegible] exposure to air, becomes [illegible] increase, and this [illegible] beneath it, from [illegible] going on [illegible] this action does [illegible] its acting [illegible] whatever the [illegible] found that iron [illegible] and water extremely [illegible]

[illegible]

[illegible] as 1742, [illegible] There is [illegible] stated in Bishop [illegible] a method (es- [illegible]), was [illegible] saucepans [illegible] The first [illegible] Mr. H. W. [illegible] of iron which [illegible] Morewood in [illegible]

[illegible]

[illegible] of sheets, [illegible] water [illegible] of wire, be- [illegible] employed [illegible] innumer- [illegible] ship fittings [illegible] copper, brass,

slate, etc. For most of these purposes the zinc coating is much more lasting, and less troublesome than paint would be; but in certain situations, as where it is exposed to the action of sulphurous compounds in smoke, and where its surface is brought directly into contact with other deleterious chemical substances its use cannot be recommended; and in these circumstances other plans should be resorted to for the protection of the iron.

There are two kinds of galvanizing, i. e., hot and cold. The

COLD PROCESS

is employed for a cheap grade of work, and is not as good as the hot process. The cold process is as follows: A pickling bath is made of a very weak solution of muriatic and sulphuric acid and water. From this pickle, the metal is washed in water "tumblers," then galvanized by immersing in a *cold* solution of sugar (or glucose) zinc and water, through which passes an electric current of from 4 to 10 volts from copper contact to zinc plates. For galvanizing small wares an automatic rotary galvanizer is used which operates on the same principle as above described. The metal parts are placed in a slowly revolving drum (part wood and part insulated metal, the object of the non-conducting metal being to prevent the zinc from coating the drum) inside of a vat of the same solution. The drum has numerous perforations allowing the free mixture of the metal and the bath. The galvanized parts are automatically dropped or dumped into another revolving draining drum and then into a gas heated metal drying drum, which completes the process. The only heat used is at the drying drum.

THE HOT PROCESS

is the original process of galvanizing. The various operations are as follows: The iron is first placed in a "pickle" of hot sulphuric acid, this bath being necessary to thoroughly cleanse the metal. If cast iron is used, it is first put through a hot hydrochloric acid bath and from there into a hot sulphuric acid bath, in order to take all sand off the casting, or to loosen the black scale, which is then scoured off by brushes dipped in sand and water.

The iron is then given a cold muriatic acid bath (called coating or aciding), and is then placed in a brick set, coke heated dry oven, and left there until the iron is thoroughly dry. The iron is then taken to the "galvanizing kettle," which contains spelter (zinc) the top of which is covered with finely powdered sal-ammoniac. The sal-ammoniac on top of the zinc bath prevents oxidation of the surface, and forms a sort of "flux" thereby preventing the iron (when placed in bath) from burning, and also helps as a coating acid. If no sal-ammoniac were

used, it would take much longer to galvanize and the metal would probably be burned while passing through the bath.

The metal is then dipped into the zinc bath (either by tongs or cranes) and after the sal-ammoniac flux on top is moved to one side, the galvanized article is drawn out, thus completing the process. If small articles are galvanized, they are immediately placed in cold water, whereas large wares are merely drawn to one side and allowed to cool.

GALVANIZING KETTLES.

These are usually brick set kettles or bath, varying in size according to the articles to be galvanized, ordinarily about 5 feet wide, 12 feet long and 4½ feet high. The walls are 19 inches thick, the inner 7 inches being enclosed on the four sides by a boiler iron compartment containing the coke fire, the top is covered by metal plates. The coke fires are started by wood and are kept continuously going night and day for five and six years at a time, as it would take a long time to get the zinc in proper form for galvanizing if it once became chilled.

DRYING OVENS.

These are usually enclosed in 12 inch brick walls with steel beam and boiler iron top, while the base is composed of half-inch iron plates, underneath which are the various flues with a coke fire at each end of the oven. The doors to the oven on each end should be constructed of $\frac{3}{16}$ inch boiler iron, reinforced with angle iron, and the flue for the escape of the acid fumes should be of brick, tile lined, and should extend above the roof line.

THE HAZARDS OF GALVANIZING.

The inspectors should advise the company as to the construction and location of the furnaces, boilers and dry ovens, and also as to the fuel to be used, coke or coal being preferable to wood. The setting of each should be investigated thoroughly, and the floor around them, or certainly that portion within a radius of, say, 12 feet, should be non-combustible. A good metal hood should be provided over the entire furnace. Coke refuse should be placed in metal (not wood) barrels, and self-closing oily waste cans should be installed.

ACIDS.

The acids, hydrochloric and sulphuric (oil and vitriol), which are received in iron drums and carboys, should be kept in a separate cut-off section, not exposed to the direct rays of the sun. An ideal location would be in a cool place on the shady side of the factory yard, as the firemen are very loath to enter buildings containing acids on account of their deadly fumes.

CONSTRUCTION OF BUILDINGS.

The usuai construction is frame, of very "light" type, with earth base. In new buildings would recommend "reinforced concrete" or "mill construction."

STABLES.

Inspectors should report whether there are open gas lights which should be protected by approved lanterns, as numerous fires have been caused by hay being tossed against same. If electricity is used the same should be approved by the underwriters having jurisdiction. Wiring should never be allowed to be hung on nails, or over piping or other metallic substances. If motor trucks or automobiles are housed the standards for gasoline, etc., will be found in "Live Articles on Special Hazards," (Vol. 2) under "Garages."

FIRE PROTECTION.

A goodly supply of fire buckets (chiefly filled with sand), a 4 inch standpipe riser with sufficient "labeled" hose and a good tank supply, an approved automatic alarm service, together with a watchman ringing hourly rounds, nights, Sundays and holidays, would make a "galvanizing plant" a fairly desirable risk from the underwriters' viewpoint.

COMMON ELECTRICAL HAZARDS.

Defects in Installations; Their Dangers and Preventives Pointed Out.

By M. E. Cheney, Electrical Engineer, Washington Surveying and Rating Bureau, Seattle, Wash.

Of our annual fire loss of over a quarter of a billion dollars it is estimated that from 5 to 10 per cent. is contributed by fires of electrical origin. While this estimate is bounded by rather wide limits, these are probably as confining as the data available will permit, numerous fires of doubtful origin being attributed to electricity, and vice versa, such fires usually destroying all evidence of their origin.

It is further believed that this estimate is quite conservative, but the loss surely is large enough to warrant the giving of greater consideration to electrical installations in the various risks. It is the intent of this paper to point out some of the commonest defects of ordinary electrical installations that any one interested, though unversed in electrical inspection, may obtain a fair idea of the degree of hazard of these, and to call attention to several matters electrical which it is believed can be so regulated as to be of considerable moment in reducing the fire hazard.

Of utmost importance and perhaps the first point to consider is the general character of the wiring. Unfortunately inspection of completed installations of other than exposed wiring is well nigh impossible. A fair estimate of the condition of a great deal of work may, however, be had from the neatness of that visible. In considering open wiring the following

DEFECTS

are common: Wires being subjected to mechanical injury are pulled off their supports and come in contact with inflammable or conducting surfaces or with wires of opposite polarity or of other systems having insufficient insulation to withstand the strain imposed upon them. Under the action of the continuous abrasion due to swinging or movement of the wire the insulation wears through and the resulting arc sets fire to the adjacent inflammable material. This often is the covering of the wire and it *may carry the flame* some little distance. Wherever wires are not

sufficiently insulated, and this refers not only to the covering of the wire but to its supports, there is located a breeding place for electrical trouble which will sooner or later start a fire.

Open wiring lends itself so admirably to extensions that the overloading of circuits is a common source of trouble. This is due principally to the fact that to carry the load the circuits must be fused heavier than is in keeping with proper protection, rendering a short or ground exceptionally dangerous because of its severity.

The matter of joints is also of importance. The pulling apart of wires at a poor joint may result in an arc sufficient to ignite adjacent combustible material. Corrosion of the wires is an unsoldered joint may so increase the resistance that under a nominal current enough heat may be developed to ignite the insulation, while in loose joints serious trouble may result from arcing. The following typical fires will no doubt be of interest in bringing out the results of the above defects:

A lighting circuit grounded on a gas pipe. The pipe was punctured and the escaping gas which was ignited set fire to the building, causing a loss reported at $18,000.

Wires supplying low potential arc light in blacksmith and machine shop, were protected by cut-out in which were fuses of 50 ampere capacity, several times larger than necessary. A portion of the circuit wiring extended into a location where wires were subject to mechanical injury and a short circuit at this point finally occurred. Heavy arcing set fire to insulation on the wires and to surrounding woodwork. Loss, $15,000.

Wires were not provided with bushings where they passed through a wooden partition. An arc formed where the insulation wore off and set fire to the building, causing a loss of $25,000. But very little can be said regarding

CONCEALED AND CONDUIT WIRING

from the standpoint of inspection of old work. Concealed wiring has but one advantage over open wiring, i. e., its freedom from mechanical injury after installation, it being subject also to the difficulties arising from poor support and from moisture. The fact that no idea can be readily obtained of the condition of concealed wiring makes any trouble that may develop of considerable moment.

In conduit installations we find a pleasing freedom from most of these difficulties. Chief of the existing, aside from those due to improper choice of materials for special installations, are grounds and shorts arising from abrasion of the insulation from improper protection of the wires where they leave the conduit. Wherever bushings or other approved terminals are omitted such trouble may occur. But little less important is the proper

grounding and bonding of the conduit system, that should a ground or leakage occur no arc could be established between sections of the system or ground nor could electrolysis by breaking down the wall of the conduit pave the way for more serious trouble. The following instances give an idea of some of the common dangers of poor conduit installations:

Wires feeding window lights in a large department store were run in iron conduit. No bushing was provided on the end of conduit and the sharp edge in time cut into the insulation of the wires as they were moved a little each time the windows were washed and formed a ground. Large loss.

Conduit passed through damp floor, near water pipe, into basement of a meat market. The circuit became grounded in conduit, the current following the damp floor, where it passed through the wood to water pipe. Electrolytic action set in, eating large hole in the conduit, but trouble was discovered before fire started.

SAFETY DEVICES.

Of no little importance is the matter of safety devices. Fuses are the safety valves of the system, and like the "good Indian" the only good fuse is a blown fuse. It was installed to protect the system and gives such protection by blowing. Strange as it may seem, few people realize this and to save the expense of replacing a blown fuse jump the terminals with pieces of copper wire or install fuses several times too heavy. A common practice is to bridge blown enclosed fuses with pieces of heavy fuse wire or wire solder and to replace blown fuses of the Edison screw plug variety by inserting a five cent piece or penny into the block and screwing the plug down on this. With such protection, or rather lack of it, a short or ground will develop a serious arc with consequences similar to what might be expected if a monkey wrench were hung on the safety valve, to which the following instances will testify:

No. 8 copper wire was used as a fuse in main feed wires, which, when grounded on pipe, allowed excessive current to pass; the resulting fire occurred during the afternoon and was promptly discovered, limiting the loss to $200.

Fire originated from a short circuit above a metal ceiling and spread through the open partition into the attic above. The original electric installation in this building was good, but trouble was caused by overloading the circuits. The sixteen candle power lamps for which the circuits were planned were replaced by one hundred and forty candle power lights. The branch circuits were fused to thirty amperes instead of six and the service cut-out was fused with strips of lead wire, No. 3 B. and S., gauge, which would carry an enormous current before rupturing. This lack of fuse protection caused a loss of $8,000.

COMMERCIAL MOTORS.

In this connection might be mentioned the hazard of the indiscriminate use of small commercial motors on the lighting circuits. The fact that these under adverse conditions draw current far in excess of their rating makes the proper fusing of the lighting circuit next to impossible, and gives rise to the dangers of overfused circuits. The fan motor is perhaps an exception to this rule as the load on these is fairly constant.

The blowing of a fuse of any but the best enclosed types is always attended with danger, and even these under adverse circumstances occasionally fail to properly open the arc. All open link fuses are a prolific source of danger, many fires being started by the hot metal emitted from these falling on combustible material. The bridging of any fuse with metal virtually creates of it an open link fuse and, furthermore, gives rise to difficulties resulting from the poor contact such bridges usually make with the fuse block terminals. All fuses not enclosed in approved cabinets having tightly fitting doors are hazardous; particularly is this true when located near combustible material. The ordinary wooden box with the loose door, flat bottom and partially lined with asbestos paper does not constitute an approved cabinet as these make an admirable place for the storage of rubbish or the collection of inflammable dust, which, coupled with the warping and opening of seams and loss of doors, makes such an affair but little better and often even worse than no cabinet. The fire records are full of instances of fires which could undoubtedly have been prevented had the cut-outs been enclosed in suitable cabinets. Following are several:

A motor operated on a 500 volt circuit was installed in a room used as a pattern shop and for the storage of patterns. Upon the blowing of a fuse in the cut-out used to protect the motor, hot particles of metal were thrown into surrounding inflammable material, causing a fire which resulted in a loss of $4,816.

Open fuse cut-out used on motor circuit blew and the fuse metal ignited inflammable material. Loss on contents and building, $15,000.

A fire took place in a dwelling where plug fuses were placed in the attic and were not enclosed in cabinet. A short circuit occurred in the fixtures, which blew the fuses and set fire to some wearing apparel which hung in immediate vicinity, causing an estimated loss of $2,000 to building and contents.

HEATING DEVICES.

All electrical heating devices are from the nature of their use more or less hazardous. Typical of the group is the sadiron. The principal hazard lies in its misuse or neglect, the majority of fires occurring from the leaving of the iron in circuit after the

work is finished. The only solution of the difficulty, aside from perhaps the employment of a switch necessitating the gripping of the handle to close the circuit, is to so wire the iron outlet that whenever current is on the iron a small lamp will burn indicating that the iron is in operation. This, however, is not infallible, for should the lamp become unscrewed from its socket or burned out no indication would be given. When, as is quite universal, the cord is equipped with a common Edison plug and may be attached to any convenient lamp socket, the hazard is greatly augmented, due not only to the impossibility of employing any indicating devices, but to the fact that a heavy load is thrown on an already loaded circuit requiring overfusing of the same and thus adding to the hazard of the iron the dangers resulting from such overfusing. Furthermore, the common key socket is designed for but 250 watts, and under the severe strain of breaking the iron circuit soon becomes defective and through failure to break the arc may be destroyed. A good metal stand on which to set the iron when hot, while not eliminating its hazard, will aid in reducing it; but unfortunately there is no way to guarantee that the stand will be used or that an iron with current on may with safety be left on it for a considerable interval of time. It is deeply to be regretted that there is at present no available means to prevent such as the following:

Current was left on an electric pressing iron in a tailoring establishment after closing hours. The iron became overheated, ignited a table and fire communicated to stock and building. Loss estimated at $5,000. Water thrown at this fire ran to basement and later caused short circuit on motor mains, which started second fire, resulting in loss to stock and building estimated at $250,000.

Tailoring flat iron was left turned on all night in a six story department store. Iron was resting on an all-iron stand. Indicating switch and lamp were installed. The heat from the iron communicated to the stand, which in time became so hot as to ignite dry goods on table on which the iron stood. Fire also traveled along circuit wires. Automatic sprinkler system operated and put out fire, limiting loss to $2,000.

A fire was started in a large dry goods house by leaving an electric iron with current on over night in sewing room. Loss, $6,000.

INCANDESCENT LAMPS.

Closely following defective wiring in the list of relative hazards comes the misuse of the incandescent lamp. The common practice of furnishing lamps with exceptionally long cords that they may be moved from place to place is to be condemned, for should the lamp be laid on or come in contact with inflammable material, fires may result. Enough heat is developed by the incan-

descent lamp to carbonize wood, cloth or paper, which would burst into flame at any minute when in this condition. Where materials of a highly inflammable nature, such as nitro-cellulose compounds, cotton, lint, etc., are stored or handled, the bare incandescent lamp is particularly hazardous. Protecting the lamp with a suitable guard in such instances reduces the hazard to a minimum. Often the breaking of an incandescent lamp in the vicinity of combustible vapors will ignite them. Where such vapors exist portable lamps should not be permitted, and such stationary lamps as are employed should be enclosed in vapor-proof globes. In show windows particularly should care be taken that the lamps are so located that in trimming the window no combustible material may come in contact with them. The use of paper shades is also a common source of danger. Whenever an extension lamp is found not protected by an approved guard one may feel assured that it stands a good chance of appearing in company with the following:

During a thunder storm, lightning temporarily disabled the service wires furnishing current to a supply store. One of the employees of the store going to the second floor to show some merchandise, turned on the key of a lamp on an extension cord, and as it did not work he dropped the lamp on top of some clothing. When the current was turned on a fire was started in the stock, causing a loss to building and contents of about $35,000

Heat from incandescent lamps in show window set fire to draperies in contact with the lamps. The building was entirely destroyed with an estimated loss of $75,000.

A show window was trimmed to represent a church wedding scene; paper candles with miniature lights were used and lamps hung with flexible cords. The fire is reported as caused either by short circuit of the flexible cord or ignition of the inflammable window decorations by the heat from incandescent lamps. The fire spread rapidly, resulting in a loss estimated at $8,000.

A fur was hung from a nail just a few inches above an incandescent lamp. The heat of the lamp in a short time became sufficient to set fire to the fur, but immediate discovery prevented more than a nominal loss.

COMMON LAMP CORD.

Too much cannot be said in condemnation of the indiscriminate use of common lamp cord. Such cord is designed and approved for pendants only and has not sufficient insulation to withstand the hard usage with which it meets in being employed for portable purposes. Risks in which the dangers arising from the misuse of lamp cord are not present are rare indeed. Cords are found twisted around nails and pipes, tied back with wire and string, stapled to walls, allowed to lay across floors and in contact with damp surfaces, are allowed to hang in imminent danger

from moving belts, to enter sockets and other fittings with no protective bushings, and are even used for line purposes. Considering the extensive abuse of the lamp cord it incites no wonder to find fires similar to the following to be so common:

A pendant lamp cord being longer than necessary was hung over a nail in wall; short circuit occurred at this point and pieces of molten metal dropped into a stock of matches. Cut-out was bridged with copper wire. Loss $12,700.

A pendant lamp cord was hanging over a steam pipe, and short circuited at this point. Pieces fell to work-bench below, igniting some paper, which in turn set fire to woodwork.

Long before cord had been knotted to take up surplus and to provide proper adjustment of lamp used for reading purposes over a bed. The constant abrasion and kinking of insulation caused by this arrangement was finally sufficient to result in short circuit in flexible cord, which threw molten metal and burning insulation on the bed beneath. Large loss to room and contents.

Short circuit of flexible cord in show window set fire to decorations, occasioning a loss of $5,000.

The short circuiting of a flexible cord at a desk bracket due to abrasion of the insulation set fire to surrounding material. Loss $879.

MOVING PICTURE HAZARD.

The moving picture hazard is so familiar a subject as to require but little discussion; but as the non-inflammable film is now a thing of the past, greater vigilance should be exercised to see that every precaution be taken to reduce this hazard to a minimum. While there is no doubt that the inflammable film gives a better picture than the non-inflammable, the latter from the fire hazard standpoint is greatly to be preferred. The large number of fires in all parts of the country immediately following the withdrawal of the non-inflammable film will testify to this fact.

In this connection it is perhaps not out of place to refer to the life hazard of moving picture theatre installations. Inspection departments have been subjected to considerable unjust criticism for an apparent disregard of the life hazard. Departments suffering such criticism are losing the benefit of a very forceful argument to bring about conditions which must necessarily also reduce the fire hazard. In equipping the projection and ventilating openings of the picture machine booth with shutters which in case of emergency may be instantly closed, aside from limiting any fire to the narrow confines of a fireproof enclosure and preventing smoke and water losses to the theatre proper, a big step is taken toward keeping the audience in blissful ignorance of any trouble and preventing such panics as recently occurred in *Newark, N. J., when* the lives of twenty-four persons were sacri-

ficed to folly and cowardice. To compel or induce the installation of such devices, it is believed that a schedule of net charges covering defects in such risks should make a comparatively heavy assessment for the lack of proper shutters and tripping devices.

While the hazard of the electric motor is much less than that of other common forms of power, there are nevertheless instances where it constitutes a material hazard. Particularly is this true of the direct current motor operating in the vicinity of combustible flyings or vapors or combustible material. Improper care of the motor whereby sparking at the brushes becomes common and quite severe greatly adds to the hazard of these installations.

COMMERCIAL MOTORS.

A paper dealing with the electrical hazard would be incomplete if mention were not made of the practice of operating commercial motors from the 500-volt trolley system. While this practice is condemned alike by engineers of both power companies and insurance underwriters, there are nevertheless but few cities able to support a street railway or through which an interurban line runs in which this hazard is not present. Such installations are hazardous because of the following characteristics of trolley service:

1. Ground Return.—In grounded systems but one accidental connection may cause a burn-out of fire. Where the ground is made in the building either through a ground plate or through connection to water or other pipes electrolysis and its attendant dangers are introduced. The ground connection further offers a convenient path for lightning discharges collected by the trolley.

2. Voltage Variation.—Due to the sudden and heavy loads thrown on a trolley system by the continual starting and stopping of cars there is a variation in voltage on such systems of often as much as twenty per cent. above and below a normal of 550 volts, as close observation of the changes in brilliancy of the lamps in the cars at night will substantiate. The surges of current following such variation in voltage causes serious sparking of the brushes, often followed by the arcing over the motor. These surges further require that the motor be fused heavier than is in keeping with proper protection. As the voltage producing such surges is often higher than that for which the safety devices were designed there is a chance that the device will not properly open the circuit.

3. The enormous energy back of such systems makes any arc or ground that may occur a very serious affair.

When power from the trolley system is furnished over a metallic circuit, that is, where current is run free of ground to and from the power house, the hazard of trolley service, while considerably reduced, still exists.

Live managers of power companies, aware of the inconveniences and hazards of servicing commercial motors from the trolley system, are as a rule anxious to discontinue such service, substituting for it direct current at a lower voltage or alternating current, and are awaiting but a good opportunity to make the change. They cannot or will not afford to provide the consumer with a new motor, but will do their share to provide an approved service when sufficient demand is made for it. If insurance companies ever expect to rid themselves of this hazard now is the time to start, and a good method is to acquaint the insured with conditions and to so instill into his heart the fear of such service, strengthened perhaps by the inference of an increase in rate if the hazard is not removed, that he will make the required demand for approved service. This method has met with no mean success in two of our cities.

Following are several typical motor fires:

Sparking of brushes on a 500 volt motor in a grain elevator ignited dust and caused an explosion and fire. Loss $25,000.

A brush holder on a motor became loosened and shifted through a considerable angle, causing arcing, which ignited dirt and oil that had been allowed to accumulate about the motor.

The sparking of a motor commutator caused by improper brush position, set fire to inflammable gases generated in building, causing a loss of $2,000.

In casting around for remedies for some of the undesirable conditions let us turn our attention first to the matter of wiring, which, when defective, is the most prolific source of electrical fires.

A good system of wiring must fulfill the following requirements:

1. Safety.
2. Satisfactory operation.
3. Convenience.
4. Neatness.
5. Economy.

That system which satisfactorily meets each of these requirements is the ideal, and it is the endeavor to reach this end that has given birth to every rule in the code. Evolution has left us today with three principal systems of electrical wiring, namely: The open cleat, concealed knob and tube and conduit. The application of the above tests to these types discloses the fact that the first two are woefully deficient, and that the conduit system closely approaches the ideal.

The defects common to open wiring have been quite fully discussed elsewhere in this paper, and while it is true that these do not exist in a new approved installation, experience proves *that it is* only a matter of time, and of a short time at that, until

through mechanical injury and extensions by incompetent persons, each and all of these defects occur.

CONCEALED WIRING.

Concealed wiring, when properly done, is a very good installation; but when it is remembered that the wire man is not the last person having access to the wiring, it can be seen how seldom good installations are obtained. The lather following the wireman and inspector, in his hurry piles lath into the wires, tearing them off their supports, places backing strips in contact with them, breaks tubes and knobs and even strips the insulation from the wires. After the latherer comes the plasterer, and heaven only knows the true condition of the wiring when the service is cut in. Owing to the difficulties encountered in rewiring the building the old wiring is used long after its natural depreciation has made it extremely hazardous. Furthermore, this system does not readily permit of expansion, and the use of higher candle power lamps and devices soon adds to the existing hazards that of the overloaded circuit. These hazards are all greatly increased by the fact that the trouble is concealed and can be discovered only after it reaches serious proportions.

Contrast with the above an approved conduit installation. In this there is no opportunity for injury of wires from external sources, and any internal trouble that may eventually develop is confined. Cabinets are imperative, being a part of the system and being of metal, are permanent. In fact, the conduit installation has the same life as the building. When the wires in the tubes become for any reason defective or are no longer sufficiently heavy to properly carry an increased load, they may be withdrawn and new and larger wires substituted.

This necessarily brief résumé of the advantages and disadvantages of the three general systems will undoubtedly warrant our drawing the following conclusions:

CONCLUSIONS.

1. That open wiring is hazardous because of its susceptibility to mechanical injury.

2. That concealed wiring is hazardous because of its concealment, and because of its susceptibility to injury during concealment.

3. That conduit wiring, closely approaching as it does the ideal, is the system which underwriters should endorse.

4. That open and concealed wiring present a fire hazard far in excess of that of conduit installations.

5. That this being the case, some inducements should be made to procure more conduit installations.

6. That no better inducements could be made than recognition of the relative hazards of the three installations in insurance rates.

7. That a difference of two cents per hundred in the rate (two cents charge in open and concealed wiring, no charge for conduit) is neither an inducement nor an equitable proportionate rate.

As strange as it may seem, the big majority of property owners are slow to realize that in case of fire they are the heaviest sufferers and that the loss usually cannot be computed in mere dollars and cents. The same people will, however, make extensive improvements to gain a lower insurance rate. In other words, of improvements affecting the fire hazard more than eighty per cent. are made with the direct object of reducing the rate rather than the fire hazard. An equitable credit for approved conduit installations, if such credit can possibly be given, would do more toward reducing the hazard of electrical wiring than perhaps any other one thing.

HOTEL ALARM SYSTEM.

There is on the statutes of the State of Washington a law requiring hotels, rooming houses, etc., to provide a local alarm system to arouse the guests in case of fire. This device consists usually of an electrical gong placed on each floor or section and arranged to ring through the agency of a series of conveniently located alarm boxes, usually flat metal cylinders with a glass front across which in bright red letters is printed, "In case of fire break glass." Chained to the wall is a small iron hammer, the use of which is obvious.

A great deal of mystery surrounds the use or rather object of these devices. Of a large number of persons questioned regarding the apparatus, among whom were hotel clerks, managers and even owners, surprisingly few knew of its limitations, the larger majority having the erroneous idea that the apparatus, aside from arousing the guests, turned in an alarm also to the fire department. It is easily seen that this misconception would lead to considerable delay in summoning the department and would unquestionably result in an increased fire loss.

Of our annual fire loss of between fifteen and thirty millions of dollars attributed to fires of electrical origin there can be but little doubt that over eighty per cent. is the direct result of ignorance and carelessness; ignorance in the proper choice of apparatus and methods and in the hazards surrounding the misuse and abuse of electrical installations and carelessness regarding the maintenance and operation of these. In the alleviation of part of these undesirable conditions municipal inspection departments are destined to play an important part.

Even in towns unable to afford the service of an electrical inspector, much good can be done by the passage of an ordinance requiring code work, and the effectiveness of this can be greatly increased if, as has been done, the local manager of the power company servicing such town is made under the ordinance, the municipal inspector. City inspection departments, however, cannot or do not give sufficient attention to old installations. Insomuch as these are the source of the majority of electrical fires, underwriters' inspection departments must necessarily concentrate their endeavors to procure the proper maintenance of these installations. Agents of the various companies would greatly aid inspection departments by giving greater attention to the electrical hazard and by reporting all installations which they feel are not up to the standard. To reduce the number of fires of electrical origin let us lend every endeavor to educate the people up to a full realization of the electrical hazard. It is a worthy cause.

ELECTRIC CAR HOUSES.

A Description of the Construction, Fire Hazard and Approved Fire Protection Equipment of the Modern Electric Car Barn—General Observations on Care and Maintenance.

By C. B. Mackinney, Secretary, Inspection Department, Starkweather & Shepley, Inc., Providence, R. I.

From a fire insurance standpoint, electric railway car houses form an important and interesting class of risks. A comparatively few years ago the class consisted of a small number of horse and cable car houses of all grades of poor construction, with poor care, no attention given to fire protection or prevention and the resulting high insurance rates. There are still some bad risks, but as a whole the class has grown enormously, values have increased by leaps and bounds, and the construction, protection, care and maintenance have improved in about the same ratio.

THE PREDECESSOR OF THE MODERN CAR HOUSE

was a very poor fire risk, usually of light wooden construction, with high shed roofs covered with shingles, hollow walls and cornices and rather large areas. The blacksmith shop, where the horses were shod, was usually in an addition with no attempt at cut-off. The lamp room, where the kerosense oil lamps for use in the cars were cleaned and filled, and which contained the oil storage, was right in the main building surrounded by a board partition. There was no easy way to get the horses out. They were usually on the second and third floors, the first floor being used for cars. Getting cars out in case of fire was not considered, or at any rate no special arrangements were made for so doing. On some systems each car had a coal stove in it to add to the possibilities of a fire starting. The buildings were lighted by gas or oil and partly heated by stoves or steam. With a few exceptions there was no inside fire protection, except possibly a few empty fire pails and an unheeded "No Smoking" sign. As the writer remembers these houses, and one's memory, as far as New York city is concerned, does not have to reach very far into the past, they were crowded, untidy, poorly constructed and poorly maintained risks.

is the reverse of all this. The street railway engineers, assisted by the representatives of the insurance organizations, have overcome or minimized the various hazards of car storage to such an extent that car houses are now considered desirable risks by the insurance companies. A car house of really good fireproof construction, housing cars built of incombustible material, would seem free from fire loss, and it is safe to prophesy that in the near future such risks will be quite common.

No hard and fast standard for car houses can be laid down, but most underwriters agree, in the main points, on what a good car house risk should be. In general arrangement they vary greatly. In a few cases we find cars stored entirely out of doors in a space which has all the characteristics of a car house, except the roof, even to fire walls dividing the area and automatic sprinkler systems. The writer has seen this open air storage in several parts of the country, more often in the cities in the Far West and the South. It has some disadvantages from an operating standpoint, and apparently is not gaining in favor.

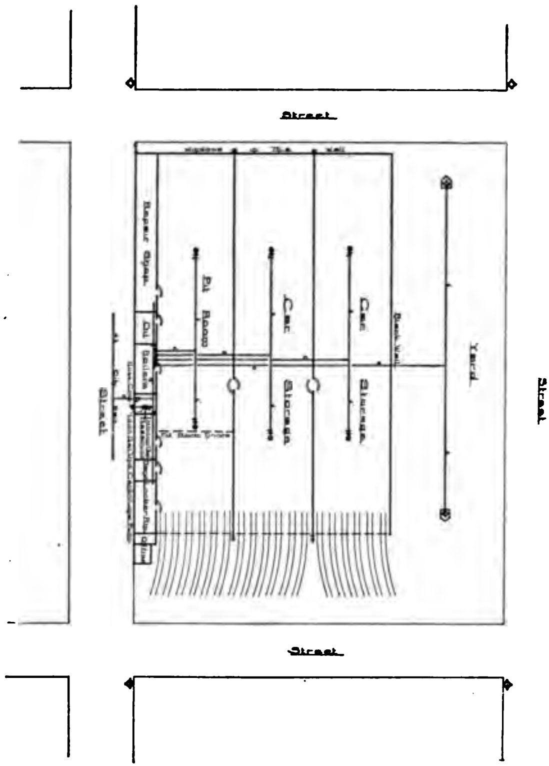
CONSTRUCTION.

We find car houses from one to four stories in height. There are frame buildings, brick joisted buildings, buildings of mill construction, and buildings of fireproof construction of various types. They have fire protection of various kinds and degrees, from none at all to complete sprinkler protection, including pits and aisles, some with sprinklers on ceilings only, and in a few cases sprinklers in aisles only. The occupancy of the buildings also varies. On most systems the car repairing, woodworking, upholstering and painting are carried on in a plant built for the purpose, and not used at all as a car house. This is as it should be, but in some houses enough of this kind of work is carried on to constitute a serious hazard. Sometimes portions of the structure are rented for other purposes. These features are of importance and should be considered carefully in judging the risk.

Car houses can be designed to meet all the ordinary underwriters' requirements without being in any way objectionable from an operating standpoint, and at a moderate cost. This result can be best attained by having the engineer designing the building confer at the start with an insurance engineer, and honestly try to carry out the few simple suggestions that will be made. If the work is then carefully and intelligently done the above statement will be found to be true, and oftentimes the cost will be no greater than if insurance requirements were totally ignored.

Some car house plants include repair shops, paint shops, trans-

former stations, and sometimes there is a power station on the premises. The following remarks apply only to buildings used exclusively for the housing and cleaning of cars, with the neces-



TYPICAL LAYOUT FOR CAR HOUSE, SHOWING TRACK ARRANGEMENTS, FIRE SECTIONS AND CUT-OFFS, AND FIRE PUMP, RESERVOIR AND MAIN PIPING FOR HYDRANTS AND SPRINKLER SYSTEM.

sary accommodations for storage, office and men's locker rooms. Repair shops and power stations contain other hazards and conditions peculiar to themselves, and should be treated separately.

Due to local conditions, each car house is an individual case and must be treated as such by both the designer and the insurance man. There are, however, a few general suggestions which may be of use to those engaged in this kind of work. To begin with, it should be remembered that a car house has within its walls

A SERIES OF SMALL BUILDINGS ON WHEELS

constructed of light, quick burning material, with inflammable finish, located closely together and constituting a conflagration hazard among themselves. Therefore, the car house building should be so constructed or protected that it will not in itself assist in the spread of any fire occurring in it. Except in rare cases car houses should be but one story in height. The most usual exception is where the house is built on a side hill, and the tracks on two floors can run out at opposite ends of the buildings, each at grade. In no case should there be any basement or open space allowed under a car storage section.

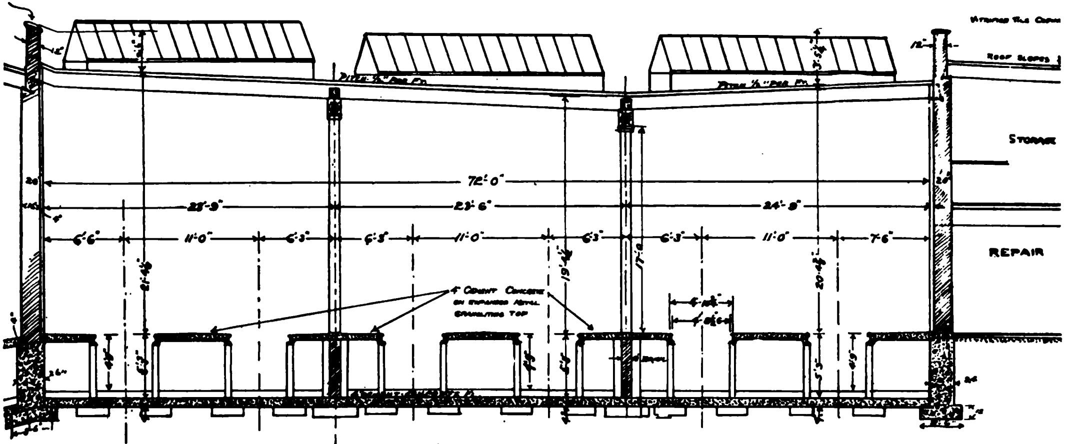
WALLS

should be of brick or concrete, and never less than 12 inches thick, and the division walls between fire sections should extend 60 inches above the roof and be as far as possible without openings. These division walls are of very great importance. There is a tendency to put more doorways and other openings in them than is necessary. The plans should be carefully considered, and every opening not absolutely necessary be done away with, the remaining ones reduced in size as much as possible and all protected with a standard automatic fire door on each side of the wall. The ends of supporting girders or timbers in adjoining sections bearing on the same wall should not come exactly opposite one another. A wooden beam dropping out would leave the end of the opposite beam exposed or nearly so, and in the case of a steel girder or lattice truss, expansion would cause damage to the adjoining section. By a little forethought this defect can be avoided.

Strictly from an insurance standpoint the smaller the section in which cars are stored the better. The operating man has a leaning in the opposite direction. A safe and reasonable limit for area of a car storage section is 20,000 square feet. A six track section of this area is a very satisfactory size for all concerned.

ROOFS.

There is a wide diversity of opinion as to roofs, and as the roof is the principal part of a one story car house and the one feature that can alone make it either a good or a poor fire risk, the subject should be carefully considered. The roof should be either of heavy plank and timber construction supported by



CROSS SECTION OF CAR STORAGE AND SERVICE SECTION—NOTE SKYLIGHTS, FIREPROOF PIT CONSTRUCTION, CUT-OFF WALL BETWEEN EACH PAIR OF PITS, FIRE WALL, ETC.

wooden posts without steel trusses or other metal members, or of one of the several systems of fireproof construction. Both of the above methods have their advantages, and both have provided some excellent results. The well known requirements of mill construction must be kept in mind if that method is adopted. If the building is to be of fireproof construction the recommendations in the building code of the National Board of Fire Underwriters should be carefully followed, or the results will not be satisfactory. Good tar and gravel roof covering is recommended for either type of construction, although metal or other non-combustible roofings may be used. The roof should be as flat and also as low as is feasible. Many houses are built higher than is necessary, which is an added expense all around, and has the disadvantage of bringing the sprinklers further away from the cars. Twenty-two feet at the highest point will be found plenty high enough for all purposes.

SKYLIGHTS.

Some form of roof lighting is necessary, and formerly the most common way to secure it was by monitor skylights or so-called lantern roofs, but these forms do not adapt themselves to modern construction. The well known "saw-tooth" skylights have been tried in a few instances. This type is not desirable, as it is more expensive to build and maintain. It offers no particular advantages in this class of buildings, and is more difficult to equip with a sprinkler system which will properly protect the cars. The best form of roof lighting from an insurance standpoint is a skylight of wire glass in metal frame. They should be kept as low as possible.

FLOORS AND TRIM.

With the possible exception of the offices the entire structure should have non-combustible trim.

Floors should be of concrete or earth. Wooden floors assist in the spread of a fire, and in some parts of a car house will quickly become oil soaked. If a wooden floor is allowed in any part of the building there should be no concealed space under it.

PITS.

The pits should be in a section by themselves. All the construction in and around pits should be non-combustible. Walls, piers and floors should be of brick or concrete, and steps should be of iron. If the pits are open from one track to another, a brick or concrete cut-off wall should be built between every two tracks. Unless the flooring between tracks is of wood no sprinklers are necessary in or around the pits.

TRACKS.

Getting the cars out of the building in case of fire is a feature that has been given a great deal of attention. In actual practice, few if any cars are ever removed. Many suggestions have been made to assist in this. One was to pitch all tracks to the street doors; another, to arrange the cars to start by throwing a switch outside the house, and there have been others equally impractical. If all tracks can be arranged to run to street without frogs or transfer table inside the house, and the track outside planned so that the cars can be handled with reasonable speed, the arrangement is now considered satisfactory. Outside track doors may be swinging in pairs, or of the rolling shutter type. The latter is more generally adopted.

FIRE PROTECTION.

Like any risk which represents a large accumulation of value, car houses should have adequate outside hydrant protection. In cities this is easily arranged, but in detached locations it is more difficult. In either case standard hydrants should be properly located about the premises, preferably at the ends of car storage sections. If in the country there should be a hose house over each hydrant with proper equipment of hose, play pipes, spanners, axes and lanterns. If in a city a smaller hose equipment will suffice, but in each case the men in charge of the house should be instructed in the use of the appliances.

It has been demonstrated in actual practice that an automatic sprinkler system properly designed and installed in a car house built along the lines we have been discussing will control fires even though they occur inside the cars. That being so, it goes without saying that a progressive street railway management will include sprinklers in a house of any importance.

AUTOMATIC SPRINKLERS.

The sprinkler systems are usually "air" or "dry" systems in localities liable to freezing. They should in most cases be installed in the usual manner. Each case should be studied, however, as in some forms of construction heads should be spaced with due regard for the relative positions of the cars and tracks. In determining on spacing it is better to lean toward too many heads in a line than to try to save a few heads by stretching the distance between heads or lines to the limit.

Aisle sprinklers are often required, and the experience, in several cases, has justified their introduction. They add very materially to the cost of sprinkler protection and are usually objected to by the operating men. They are subject to accidental damage, and when put out of commission in this way it sometimes results in the whole risk being without sprinkler

protection for a time. The writer has examined risks where the regular ceiling system has been omitted and sole reliance placed on aisle sprinkler lines. This cannot be considered good practice.

As an aisle sprinkler system may be a novelty to some, the following extracts from the rules of the National Board of Underwriters may be of interest in showing just what such a system should be:

In addition to the regular ceiling installation, sprinklers to be placed on both sides of each track in an upright position, on horizontal pipe

VIEW OF LARGE CAR HOUSE PLANT—THIS IS REALLY TWO HOUSES BACK TO BACK—IT REPRESENTS A TOTAL VALUE OF OVER $1,000,000 AND IS CONSIDERED AN EXCELLENT RISK.

lines, parallel with tracks, and to be so located that water will spray directly into cars through side windows of car bodies, the sprinklers to be at such a height that their deflectors will be from two to four inches below the upper sash rail of car windows.

Distance between sprinklers on aisle lines not to exceed 8 feet.

The standard pipe schedule to govern installation of aisle lines, except that no pipe smaller than 1 inch to be used.

When the distance between sides of cars on adjacent tracks does not exceed 4 feet, one line of sprinklers to be placed in the centre of each aisle between tracks.

When the distance between sides of cars on adjacent tracks exceeds 4

feet, two lines of sprinklers to be installed. Sprinklers to be placed not less than 6 inches, nor more than 12 inches from the sides of cars to be protected.

When the distance between the sides of cars in adjacent tracks is less than 12 inches, or where aisle lines in accordance with this section may not be practicable, as at curves, switches, transfer tables, car elevators, repair and paint shops, special instructions from underwriters having jurisdiction should be obtained as regards installing raised or altered lines.

Sprinklers to be placed between cars and partitions, division or outer walls, not less than 6 inches nor more than 12 inches from the sides of cars to be protected.

It is recommended that aisle sprinklers be provided with a shield to protect them from spray of overhead sprinklers, and to serve as a means of banking heat waves.

WATER SUPPLIES.

Adequate water supplies for hydrants and sprinkler systems should be provided. It is important that there be two independent sources of supply, each of good pressure and of ample capacity. Where the city water is available it is generally used, backed up by pumps, gravity or pressure tanks. Here again each case must be considered individually. It should be borne in mind that sprinklers in a car house are at a disadvantage as compared with those in an ordinary building. They oftentimes cannot get at the incipient fire and extinguish it. A fire is likely to gain considerable headway inside or underneath a car, and when it does break out the heat will open a large number of heads at once. This will tend to weaken the efficiency of the sprinkler system if the water supply is not ample. Where aisle sprinklers are used, the draft on the water supply is apt to be much greater than where only the ceiling system is used.

Gravity tanks can only be considered as a fair water supply for this type of risks, and the necessary steam power is usually not available, so that steam pumps are impracticable. The best solution so far found to the problem of water supplies is the direct connected electrically driven centrifugal pump. For this service a two stage pump taking its suction at a slight head has been found to be satisfactory.

Suction supply can be provided by building under one of the sections of the house a reservoir containing enough water to supply the pump at its rated capacity for one hour or, preferably, longer. This forms a good suction supply, as it is close to the pump, it takes up no room, is subject to no deterioration, costs nothing to maintain, and when incorporated in the design of a new building is not expensive.

The pump should be connected to both sprinkler systems and private hydrants. It should be located in a room cut off from the rest of the risk and with an exit opening out of doors, so that it can be reached under any conditions. The electrical arrangements will vary with local conditions, but they should be simple, and a current supply should be selected that, other things

being equal, will be as free from interruption as possible. The motor is the most delicate and weakest end of the pumping equipment, and should be well designed, well made and well taken care of. The pump is well nigh "fool proof" and with almost no care will do its work and do it well.

FIRE ALARMS.

It is very necessary in a car house that prompt notice be given of any fire that may occur. For this purpose a complete alarm

VIEW INSIDE OF HOUSE OF STEEL AND CONCRETE CONSTRUCTION, SHOWING AISLE SPRINKLERS—THIS PICTURE WAS TAKEN IMMEDIATELY AFTER A FIRE WHICH HAD BEEN EXTINGUISHED BY THE SPRINKLER SYSTEM—NOTE THE UNPROTECTED METAL WORK.

system should be installed in connection with the sprinkler system. Each "wet" system should have an alarm valve with alarm connections, and the air valves on the "dry" systems should also be so fitted. A satisfactory arrangement is to have all the valves in one section connected to one water rotary gong located either in

or on the front wall of the section, and in addition have each valve electrically connected to its own numbered drop, on one or more annunciators located in the office or other appropriate place. Provision should be made for testing the alarm system by actually operating the motor gongs and electrical attachments, and this without disturbing the air valves.

EXTINGUISHERS AND WATCHMAN SERVICE.

In addition to sprinklers there should be an equipment of chemical extinguishers and small hose. Fire inside of car bodies are not often entirely extinguished by the water from the sprinkler systems, and the use of hand appliances becomes necessary. These equipments will vary, and should be laid out to meet each case.

If there are men on duty in a car house night and day no watchman system is usually necessary. If, however, the house is left without regular men at night, there should be a watchman in charge, who should make regular rounds and register them on an approved time recorder. If a house of several sections has any part of it left at night without attendants, a similar watchman service should be arranged.

THE HAZARDS OF THE MODERN HOUSE

are not very many or very complicated compared to those of the houses in the time of the horse car or its early electric successor, but a brief mention of them is essential. The lamp room is almost a thing of the past. Some roads still use oil headlights and tail-lights. If they are to be cared for it should be done in a room cut off from the rest of the building, and the supply of oil properly safeguarded. There is always an oil room where lubricating oil, grease and other necessary inflammable materials are stored. This should be in a section by itself, preferably detached and built of fire resistive construction. If it communicates with the car house proper the opening should have a threshold at least 6 inches above the floor and be protected by a standard swinging fire door kept shut by a weight. Sliding doors are not tight enough for this purpose.

Sand for use on the track is usually dried so that it will run without clogging in the spouts of the sand boxes. This is almost always done now by steam and is non-hazardous, provided the hot sand is kept away from woodwork. If the old fashioned coal heaters are used, care should be taken that they be safely installed.

Pits were formerly hazardous places, but those of modern construction are not, provided they are kept clean. Care should be taken that they be kept free of unnecessary spare or broken parts, oily waste and accumulations of grease and oil.

are light. The wiring should, of course, be in accordance with the "National Electrical Code." The wiring should be in metal conduit, and switches and cut-outs should be in metal cabinets to protect them. If a suspended trolley wire is used inside of the building it should be supported at such frequent intervals that should it part the ends would not touch the ground. A switch should be provided at a point 200 feet from the building or section that can be used to cut the current off all the trolley wires inside the house and over the adjoining tracks. This is for the safety of the men fighting a fire. This switch should not cut out the lights, however.

CAR HAZARDS.

The cars have some hazards of their own which should not be overlooked. Most cars have hollow spaces which collect rubbish of all sorts, which from either electric or other causes often gets on fire. If the car has a smoking compartment, lighted cigar and cigarette butts find these accumulations. Some systems use coal stoves to heat the cars. Of course, these fires should be extinguished before the car is allowed to be run into a house. Fires from electrical causes are frequent in cars. These are reducing in number, as the wiring is done very much better than formerly, but there is still room for improvement. On account of the construction of a car and the fact that the electric wiring and devices are subjected to dampness and very rough and careless handling, more or less trouble is to be expected. The rule not allowing the car to be on circuit while standing in the house, however, removes the danger of electrical fires, unless the car was already on fire when it was run in.

The small repair shop, boiler room and locker rooms have no particular hazards, nor are they noteworthy.

CARE AND MAINTENANCE.

A car house that is well designed, well built and well protected will still be a poor risk unless it is well taken care of. First, and of the utmost importance, is cleanliness, or "housekeeping," as it is sometimes called. The entire premises, including the inside of the cars, should be kept clean, and all oily waste, sweepings and useless articles and materials should be removed or burned up under the boilers. This sounds like a simple thing to have done, but it is not. One reason for this is that the higher officials who really have the power to enforce such a rule oftentimes consider it of no importance or beneath their dignity.

A rule should be made and enforced that trolleys of cars in storage must not be left in contact with trolley wire. This is sometimes hard to enforce, and ignoring this rule has caused more electrical fires in cars than any other single cause.

View Inside of House of Mill Construction, Showing Ceiling Sprinklers, Roof and Pit Construction.

Someone should be in charge of and responsible for the fire protection appliances in the risk. He should be a man of recognized authority, whose other duties keep him on the premises most of the time. He should, of course, thoroughly understand the apparatus under his care. Very satisfactory results have been

obtained by having this man make out and sign a weekly inspection report form, which should be kept on file in the office of his superior.

The following shows what points such a report should cover:

1. Are all valves supplying water to sprinklers or hydrants open?........
   If not, note exceptions..
   Are all these valves strapped?..................................
   If not, note exceptions..
2. Are all dry valves in sprinkler system in proper operative condition?...
   If not, note exceptions..
3. Has water entered any dry sprinkler system during the week?........
   If so, why?..
4. Are all alarm devices in connection with sprinkler system in operative condition?.......... If not, note exceptions.......................
5. Is gravity tank full, and free from ice?............................
6. Is water at proper level in pressure tank?..........................
   Is air pressure at least ———— pounds?..........................
7. Have pumps been started during the week?..........................
   Are they all in operative condition?...............................
   If not, note exceptions..
8. Are any automatic sprinklers corroded, bent, painted, whitewashed, or obstructed in any manner?......................................
   If so, note location and particulars...............................
9. Are all fire pails and chemical extinguishers in place and ready for immediate use?...
   If not, note exceptions..
10. Are all fire doors and shutters closed and fastened every night, and at all times when opening is not in use?.........................
    Are all automatic attachments in order?............................
    If not, note exceptions..
11. Are all hydrants unobstructed and in operative condition?...........
    If not, note exceptions..
12. Are all hose, play pipes, spanners and other hose house equipment in their proper places and in good condition?.......................
    If not, note exceptions..
13. Is there any accumulation of waste, rubbish, useless articles or inflammable materials in any part of the buildings or yards?...........
14. Has there been any change during the week to the buildings, partitions, piping and machinery, which in any way affects the fire hazard?..................................
15. If anything about the premises was found to be defective, or in an unsatisfactory condition, what is being done about it?..............
    Date.........................
    Signed.....................................

It is also important to impress on the man in charge of the house and all the force in and around it the importance of fire prevention and protection.

A few years ago the writer made an examination of and reported on one of the most important electric car systems in the country. The "housekeeping" was not good, and the closing paragraph of the report explained why. It was as follows:

Your inspector gained the impression from employees that he came in contact with that the men actually in charge of the risks and the crews under them did not take the matters of fire protection seriously. Many of them discussed these matters flippantly, and evidently did not realize their importance. This attitude is distinctly against the best care and mainten-

ance of the various premises, and the fire equipment thereon. Serious fires are possible and even probable, in many of the locations, which would cause not only heavy property loss, but what is probably of more importance to the assured, a serious interruption in service. Conserving these properties in working order, and preventing fires therein, is therefore fully as important as any other duties of the employees, and it would be to the advantage of all concerned if this were firmly and emphatically impressed on the entire personnel.

We have briefly considered types of construction and there are well defined standards governing the details, whichever is selected. By following the above suggestions a house will be built in which under worst circumstances a fire will be confined to the fire section in which it originates. This means a loss of not exceeding $250,000. There will be on walls and pits considerable salvage, which will also be quite an item in the saving of time to the railroad in replacing the building. The arrangement and construction of the floors and pits aim at having no inflammable material below the car floor. This will result in salvage on the trucks and electrical apparatus under the cars, as well as on the pit structure itself.

Each of the different general types of construction has its advocates. The writer's experience rather shows that a properly designed house with brick walls and flat plank and timber roof is the best from all points. The illustrations show this construction in detail. There is no structural metal members to be warped by heat, no fireproofing to be knocked off and no danger of collapse if the building is subjected to the severe heat of burning cars. Plank and timber construction will hold against a fire a much longer time than is necessary to consume the contents of a car house, and even if, due to fire or some accident, a post is destroyed or knocked out of position, only a small area of the roof structure will be damaged.

The installation of electric wiring and piping is much more simple than in the case of a building of fire resistive construction.

The illustrations, Nos. 1, 2, 3 and 4, show a typical car house of plank and timber construction, which not only is considered an excellent fire risk, but has been declared a success by the operating men of the road on which several of this type are located, and it can be built much more cheaply than if one of the systems of fireproof construction were used.

NOTABLE CAR HOUSE FIRE.

Description of Damage to Risk Described in Supplement of November 2—Lessons Drawn from the Experience.

By C. B. Mackinney, Secretary, Inspection Department, Starkweather & Shepley, Inc., Providence, R. I.

In the preceding article the writer described a carhouse for the housing of electric cars, of plank and timber construction

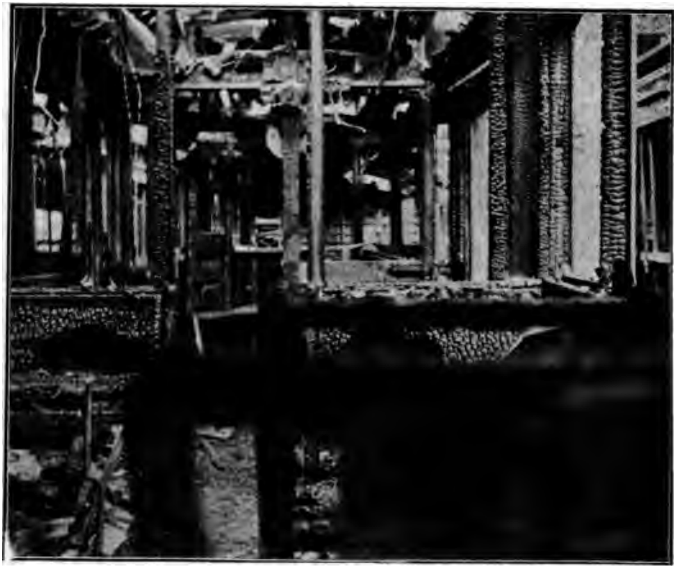
INTERIOR VIEW AFTER FIRE.

with brick walls, and gave some reasons to show that this type is the best from all points of view.

Recently a fire occurred in a house of this type which showed that the theories involved are correct. An illustration of the outside of this house is shown on page 121, and on page 126 is an illustration showing the approximate location of the fire, all tracks

being filled with cars at the time it occurred. These now have added interest when it is stated that a fire starting under adverse circumstances in the midst of over $1,000,0000 worth of cars was controlled and extinguished, in the manner that the designers had intended, with a property loss of $3,000.

The car house is a large one, being roughly 165x710 feet, and divided by fire walls into several small office and shop sections,



THE CAR IN WHICH THE FIRE ORIGINATED.

and four car sections, the largest, being the one where the fire occurred, containing about 30,000 square feet and 2,617 feet of track. The building is but one story, about 23 feet in height, with brick walls and flat plank, and timber roofs, with wooden posts and tar and gravel covering. The roof has numerous metal skylights, glazed and wire glass.

THE SECTION WHERE THE FIRE OCCURRED

has pits under the tracks which are of steel and masonry, there being no wood or inflammable material used in this part of the structure. These details of construction are shown in the illus-*tration on page 118.*

The entire building is equipped with a modern "dry" sprinkler system. The section where the fire occurred contains 407 sprinkler heads on two 6-inch air valves. The spacing is approximately 9 feet apart in 10-foot bays, with additional heads in skylights. There are no sprinklers in the aisles or pits.

The water supplies consist of two 6-inch connections with the city mains at 45 pounds pressure and an electrically driven centrifugal pump. It was found unnecessary to start the pump.

The section in which the fire occurred contained, at the time of the fire, seventy-two cars, many of which were "bloomers" on storage. The house is open day and night, as, except for a few hours in the early morning, cars are entering or leaving at all times. It was in charge of a foreman, two pit men and two sweepers. They were all on duty at the time.

THE CAR IN WHICH THE FIRE ORIGINATED

was run into the house at 6:45 p. m., and the several cars between it and the street were run in about the same time. It is the custom in this house to have a man go over the roofs of the cars at 11 o'clock p. m. to see that the trolleys are not in contact with the trolley wires. This was done as usual, and the trolleys of this car were both hooked down at that time.

At 2:10 a. m. the crew of a passing car discovered the fire and about the same time the alarm on the sprinkler system rang. The men in charge pulled the city fire alarm box and immediately started to remove the cars from the section. When the fire was discovered it had gained considerable headway. The car in which it started is shown in the diagram as car No. 677. It was a large car of "suburban" type, with a baggage section in one end with few windows in it. The fire started in one corner of this section near an electric heater; the cause of it problematical. Car heaters do start fires, but if the trolley had been off the wire for eight hours as reported it does not seem probable in this case. Also as car No. 670 of the same type which stood next to the burning car was found to be on fire inside, after it was removed to the street, it is difficult to explain just how the fire occurred.

The fire evidently burned in the baggage section for some minutes before breaking out of the skylights, and into the body of the car. Had it started in the passenger section it would have broken out of the car before it gained so much headway, and would have been extinguished more easily. As it was it burned for some time before the sprinkler system was put into operation. Twenty-nine heads opened which entirely surrounded the burning car and promptly put the fire under control. The car house attendants moved enough cars into the street so that the firemen

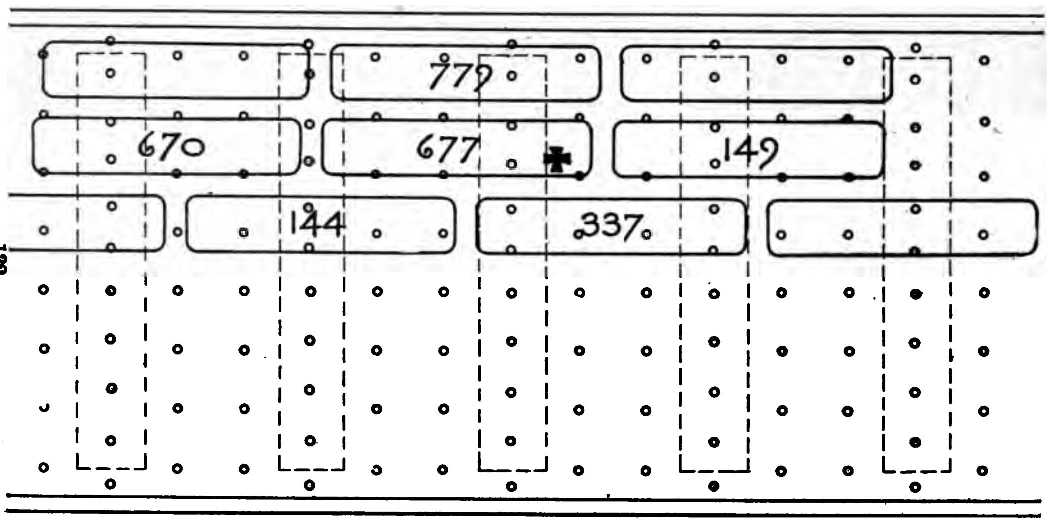


DIAGRAM SHOWING RELATIVE LOCATION OF CARS.

could get at the burning car. The fire was easily extinguished by chemical streams.

THE OPERATION OF THE SPRINKLER SYSTEM

was very satisfactory. Although it was handicapped by the type of car that was burning, it held the fire *to the car in which it originated,* and the fire was extinguished without damage to the car *below the car floor.*

INTERIOR VIEW SHOWING CROWDED CONDITION.

As shown by the diagram and photograph, the section was filled with cars crowded as closely as possible. The fire started in No. 677, which was near the centre of the section, broke through all the windows and skylights, including those in the vestibules, burned through the roof of the car and damaged the body so that it was found necessary to rebuild it down to the window sills, yet the damage to Nos. 779, 144 and 337 is confined to a little blistered paint and varnish. Car No. 149 is not damaged, evidently being protected by the water from the sprinklers. The same applies to car No. 670, except that it was slightly damaged from the separate fire which originated inside of it as stated above.

The building itself took no damage except for a slight scorching of the roof planks immediately over the burned car. The damage to the contents of the building outside of car No. 677 amounted to $250.

THE FIRE CLEARLY DEMONSTRATES

(1) that a car house designed and equipped as outlined can be considered satisfactory from an insurance standpoint. Had the building been of fireproof construction the results could have been no better; (2) that aisle sprinklers would not have reduced the loss at all; (3) that a house of any considerable size should have men in attendance at all times; (4) that track systems designed to facilitate the removal of cars in case of fire are of great importance. This has not been so considered by some, including the writer; (5) that in ordinary fires in houses of this type there should be little damage to the building or to the rolling stock below the level of the floors of the cars.

DRY GOODS STORES.

Dry Goods Stock—Its Susceptibility to Damage and Chances for Salvage.

By Clarence Elton Allan, Adjuster, San Francisco, Cal.

The purpose of this paper is to describe the conditions that would probably exist in a dry goods store after a fire which had caused a partial loss, and to discuss the effect of fire, water and smoke upon the dlifferent classes of stock.

No two fires are alike in their effect, and in order to make the discussion complete it will be assumed that all departments have suffered some damage. This store we will consider as located in a town of from 10,000 to 20,000 population, situated at some distance from a large city, and containing stock of approximately $50,000, consisting of the classes of goods and their relative values which are shown in the list.

You will understand that the values that I have quoted are not necessarily those which would be found in every store containing a stock of this nature, although I think that the relative values given are approximately correct. Various conditions, such as accessibility to trade centres, class of people or season of the year, would materially change the amount of stock on hand in certain departments.

Silks	$3,500
Woolen dress goods	2,500
Wash goods	2,000
Table linens, towels and domestics	2,500
House furnishings	2,500
Ladies' neckwear and veiling	800
Laces and trimmings	3,500
Gloves	1,200
Handkerchiefs	600
Notions	500
Embroideries	1,500
Ladies' hosiery and underwear	2,500
Muslin underwear and infants' goods	2,000
Corsets	700
Knit goods and yarns	400
Ribbons	1,000
Art goods and embroidery silk	1,500

Millinery	$4,000
Paper patterns	800
Ready-to-wear goods	9,500
Men's furnishings	6,500

The statements made and opinions expressed regarding damage are not final, but are presented for the purpose of inviting discussion. The subject under consideration is by no means exhausted; but it would be impossible to review every department fully in the time allowed for a paper of this kind.

It must be understood that in speaking of water damage only that damage caused by clean water is considered.

SILKS.

The damage in this department is greatly feared by the merchant, and must be very closely watched by the adjuster. In proportion to the space it occupies the value is greater than in any other department in the store, and a very small percentage of loss here would mean a very much larger loss in money than where the value is not so condensed. The poorer the quality of silk the greater the damage; in fact, if the silks were pure the damage would be very slight, except in the fancy shades, which would streak or spot. A cheap taffeta or surah is about 95 per cent. cotton, and every color will run if wet. Silks should be given immediate attention by the adjuster, as the damage accrues very rapidly. The colors running in some of the silk will almost invariably spread to other parts of the stock and discolor the best grades, which might not otherwise be affected. There is another class of damage caused by the manner in which the stock is kept. With few exceptions silks are single width and are folded either in yard, meter or yard and a quarter lengths, covered on the outside with a light weight and pliable pasteboard. It is impossible to keep handling these goods without tearing the covering, and as the tear usually occurs at the double edge the centre of the silk is affected. Dyes running from water damage would very quickly permeate a whole piece of silk and completely ruin it; especially is this true in the thinner or lighter grades, as the damage in this case being crosswise of the goods would show in every yard. To get rid of the stain it would be necessary to cut out a piece in every fold. To prevent some of this unnecessary damage the insured should immediately examine very carefully every piece of silk and cut off the affected lengths before the damage has a chance to spread.

In goods which are rolled, such as linings or dress goods, the damage even on the double fold is not nearly so great as in the silks, because by cutting off the double edge, which is lengthwise of the goods, you have two pieces of perfect goods nearly half the width of the original. This statement is not quite as

good as it sounds, for the reason that the minute you cut the width of the material you put a limit on its utility. The narrower the raw material the more seams are necessary in the manufactured article, and a great many manufactured articles will not allow joining. Nevertheless, the value of this half width material would be much greater than the yard or yard and a quarter length in the folded goods. The smallest loss in this department, unless increased by damage communicated from other silks, will be in the gros grains, wash and summer silks, as these can all be washed. The damage to velvets, velveteens and corduroys is governed by the quality. Velveteens being cotton, the color will run and the pile will be flattened beyond restoration. The silk velvets with cotton backs are affected very much in the same manner; even a few drops of water seeming to spot them badly. I do not think a stock of this size would possess much silk velvet, but, contrary to general opinion, it would not be affected to any great extent by water. If you were to soak a piece of silk velvet in water you could take it out, shake it thoroughly and dry it, and it would not show any ill effect. The common method used by milliners to freshen silk velvet is to hold it over steam. The cheaper grades of corduroy are filled with a glue preparation, and these waters will, in small quantities, spot, and in large quantities take all the body out. The best grades of corduroy are almost undamageable by water.

LADIES' NECKWEAR.

This department comprises all classes of neckwear, from the small turnover collar to the high priced neck ruches, and usually includes the veilings. Neckwear is made of various materials, nearly always of a perishable nature; malines, chiffons, silks, laces and ribbons being some of the fabrics used. Malines and chiffons are a total loss if wet. Tailor made and hand embroidered neck pieces are not subject to very much loss, as they can be reconditioned. Other neckwear under the best conditions is very susceptible to damage, although one thing in its favor is that it is usually kept in glass cases.

LACES AND TRIMMINGS.

This is a department where the value is great, but if the stock is kept in wooden boxes the loss will be comparatively slight. Gold and silver are commonly used in the trimmings and should be handled at once, if tarnish is to be forestalled. What are known as gold and silver cloths are very expensive and should be looked for and dried quickly, as they will become a total loss if allowed to tarnish. Any silver or gilt trimming will tarnish from age, if kept in stock for a long time. The tarnish from age is usually general, while tarnish from water will show in either spots or streaks. Mohair braids or trimmings will dam-

age little, if any, from water, except in the bright colors which may run. Water will draw a great many of these trimmings out of shape, as they are frequently made of various combinations of wool, cotton, silk and mohair, and the effect of water is different on each material. When wet, one material will shrink or stretch away from the other and draw the trimming out of shape.

The damage to a trimming lace is much greater than to an ordinary wash lace. The actual damage is not greater, but the utility is impaired in the former instance and not in the latter. A wash lace is nearly always put on a garment that will be washed, before it is used, while a trimming lace is put on a garment not intended to be washed; or if washing is necessary the lace will be taken off, washed and put on again. Very few laces look as well after washing as before, and washing naturally shortens the life of any material. Laces with any dressing or filling are seriously affected by water. Water will absolutely ruin any laces made of fibre. Irish crochet and Cluny laces are damaged very little, if any, by water. Point laces are of a peculiar shade, and if washed would probably lose, to a certain extent, that very important characteristic.

CORSETS.

The corset department should be one of the first to be examined. Corsets are always kept in individual cardboard boxes, and for this reason smoke or heat will probably not reach them, but the damage from water is most to be feared. The frames of the corsets are either whalebone or steel, and are covered with various materials, such as twills, batistes or brocades. The poorer grades of corsets have steel frames, which will rust, and rot the covering, if left for any time. The better grades are whalebone, but there always is at least one steel in the front. Nearly all the French corsets are brocaded, or have light flowered patterns, and water will spoil the appearance of these. Rust will keep working its way through to the surface, and when the corset is worn will spoil other garments. In the better grade of corsets the steel is better protected than in the cheaper grades, and, therefore, is less liable to damage. Corsets are harder to sell when damaged or stained than most merchandise, although, unlike some wearing apparel, the higher priced damaged ones could be sold, if priced low enough, to a person who could not afford the high prices. If so bought the purchaser would probably take out the steel, wash the corset, dry thoroughly, and put in a new steel. Practically all of the possible damage could be avoided if the stock were handled quickly. The corset should be removed from the boxes and paper and hung on lines to dry. This method of procedure might be objected to by the merchant, for the reason

that it is usually hard to identify merchandise if once removed from the wrappings; and in the case of pair goods there is always the danger of unmating. This objection does not hold good in this case, as corsets have the pattern or style number and the size stamped on each pair, so can, when thoroughly dried, be replaced in the dried boxes or in new ones secured for the purpose.

HANDKERCHIEFS.

The actual damage possible for handkerchiefs to sustain is very light, but the stability is affected. In some materials it is better to sell the article "as is" after a fire, and in some cases it is advisable to recondition. The question as to where to do one, and where the other, is always a problem. As an illustration, a handkerchief that sells for twenty-five cents, if smoke-stained or wet, would probably sell "as is" for ten or twelve and one-half cents. If the same handkerchief were laundered, at a cost of two and a half cents, it probably would not sell for more than fifteen cents. Therefore, it would be advisable to sell "as is," instead of laundering. In the better grade of handkerchiefs the expenditure for laundry would probably be advisable. Another thing to be remembered is that in selling an article "as is" the purchaser takes the chance; while in conditioning it, the merchant takes the chance; and unless the possible gain is considerable, it would not pay him to do so. Again, any article as sheer as a handkerchief, if badly smoke-stained, might not be entirely free from stain after one washing; therefore, it would be harder to dispose of than if it had not been washed at all. The prospective purchaser would see that it had been laundered, and would naturally presume the stain to be permanent.

NOTIONS.

These are made up of a great many small articles, no one of which is of any great value, but in the aggregate they run into money. In this department a person could find a small sample of almost every class of damage possible in a dry goods store. All the up-to-date stores have a notion case commonly called "the silent salesman," which is about the size and shape of the ordinary floor case. It is composed of about sixty drawers of graduated size, so arranged that every article can be seen. This case will keep out water and smoke, but if subjected to much heat it will sweat and rust anything with metal on it, and most of the notions have some metal parts. Very little can be done here to prevent damage, and nearly all the articles are so small that the possible salvage would not pay for the time and labor in saving. It would be advisable, perhaps, to open the case in the hope of preventing the steam from generating.

can be broadly classed under three different headings: (1) Staples, such as velvets, velveteens, silks, laces, trimmings, ribbons, wires and buckram. (2) Plumes. (3) Fancies, consisting of flowers, feathers, birds, malins, chiffons and ornaments.

The staples have been passed on before in their respective departments. The only difference here is that the staples are more than likely to be in fancy colors and are therefore subject to greater damage. In the fancy section the loss is very excessive. Flowers are nearly always wired together, and even when this wire is covered the water will reach it at the joint, and in a short space of time the wire will corrode, and the flower will separate from the stem. In nearly every style of fancy the joining is done either by wire or glue, and when the wire is affected, as above stated, the glued fancies will all fall apart, water seeming to kill all the virtue in the glue. Wings and birds are sometimes put together by the same method and the same damage results. Feathers will, if wet, stick together in little bunches. They will never, even after drying, look the same, and are decidedly unsalable. Plumes are the best of the articles that are not, strictly speaking, staples. French plumes, even after they have been thoroughly drenched with water, can be dried and recurled and will look very well. The willow plume, which is the most popular today, is made up with the French plume as a foundation, and other French plumes are cut up and each little flue or fibre is tied either with a double or single knot to each separate flue of the foundation plume. This procedure is sometimes followed three or four times, thus making the plume very long and expensive. The damage to willow plumes is very great, as they cannot be recurled owing to the knots. Only the tip is curled, but water will loosen the knots, causing the plume when handled to fall apart. The cost of new French plumes to restore the willow plume to its original condition would be as much as its whole original value.

Malins and chiffons are absolutely of no value if they are once badly wet, even though the colors are fast. A starchy substance is used to give them a certain body and sheen. But as soon as moisture touches them the life immediately leaves them. The buckles and ornaments are subject to different degrees of damage. They are made of cut steel, glass, aluminum, celluloid, rubber and bone. The glass will not damage unless the fire actually touches it; celluloid will ignite if exposed to very little heat. The rubber ornaments are made of some substance in conjunction with rubber, and it does not take much heat to melt them. I have seen numbers of such ornaments melted and r[illegible]hen they have been stored in drawers of which the [illegible]t had not even blistered. Untrimmed hats or

shapes are made of various materials, such as felt, velvet, or straw. Felt will spot from water worse than any other material, and the cheaper the felt the more susceptible it is to damage.

The principal damage to the untrimmed velvet hat is in the lining, which is usually of buckram. This buckram, when exposed to dampness, will shrink away from the velvet, and even if the velvet is not affected, will cause serious damage, as the value of an untrimmed velvet hat is usually more than 50 per cent. labor. In straw shapes the damage is regulated by the grade of material. Straws of poor grades are filled with glue dressing and water will take all the shape out of them. The better grades of straw keep their shape very well, and will reblock. The Panama straw will not be damaged by water at all. The method used to clean them is usually soap and water and a scrubbing brush. To reblock a Panama straw it is steamed or soaked in water and then put on a block and reshaped. Generally the only chance for salvage to be realized on a trimmed hat is the possibility of some part of the trimming being utilized. It is harder to dispose of damaged millinery then any other stock.

RIBBONS.

The manner and position in stock will govern the damage here to a large extent. All the wider widths of ribbon are rolled in ten yard lengths, on a pasteboard centre, or hub, in paper which is made expressly for the purpose to protect them from dust and dirt. The paper is always about an inch wider than the ribbon and is rolled so as to leave nothing but a half a yard of ribbon exposed. When kept in glass wall or show cases the damage is quite light. The bolts of ribbon are sometimes stood on end, on top of each other, and sometimes laid sideways on long racks. The bolts on end are subject to much greater damage than those that are laid sideways, as the water dropping on them will go through the whole bolt of ribbon by way of the open edge, and streak the whole piece, while in those that are laid sideways, it cannot penetrate further than the outside yard or two unless left to soak in. The ribbons so kept must be handled quickly, as the paper used is porous and will absorb water. The smoke damage is sure to be light, as the smoke cannot come in contact with any great amount of ribbon, due to the protecting paper. All the narrow widths of ribbon and also the velvet ribbon are kept in boxes. The velvet ribbons must be kept away from water, which affects them the same as it does the material. In some ribbon departments fancy bows and novelties of all descriptions for woman's wear are made up and kept on display. These novelties are generally made of the most delicate shades and colors and are very perishable, and the chance of damage is very great. The

natural damage resulting from shop wear, dust and fading must be eliminated before the fire damage is estimated.

GLOVES

are very susceptible to damage. Ordinary work gloves are damaged less than any other, due to the method in which the skin is tanned. They are made of various skins such as calf, hog skin, horse hide or dog skin, which are all oiled and tanned. Smoke or water will have little if any effect on them. The principal damage will arise from the clasps or fastenings rusting, and rotting the leather immediately around them.

Dress and walking gloves are of a different finish and are powdered. These will spot readily from water and will mildew. Intense heat will draw up powdered gloves even when fire does not actually touch them. The undressed and mocha gloves will stiffen up and become very hard when wet, and the danger from the rusted clasp is the same here as in the working glove. If a glove is damaged it is very hard to sell. Unless a glove was of the proper color or weight to be sold as a working glove it would be useless. The opera lengths and shades are worthless if stained. Silk and lisle gloves are not materially damaged and will readily sell at a reduced price. Kid gloves will often mildew or rot if kept in stock too long, and claim for this class of damage must be guarded against. The saving feature of a glove stock is that it is usually kept in heavy stock boxes and thus in a small fire it is hard for smoke or water to reach them. It is very important that gloves be cared for quickly as the value for the size of stock is greater in this department than any other in the store.

WOOLEN DRESS GOODS.

Woolens of all kinds are supposed to be affected quite readily, particularly by smoke. Smoke damage should not be claimed or allowed unless a trace of discoloration is evident on the material. Of course the porous or loose texture woolens will take the odor of smoke, even without discoloration, but this odor will leave the material if given a chance in the fresh air. You have probably noticed the odor of smoke very strongly without a stain showing; but if you will recall the circumstance to mind you will remember that this was in cases where the material was so dark that smoke could not show anyway. Woolen dress goods are quite damageable when many light shades are used, as is the case at present; but they are mostly solid colors. They are all covered on the outside with a heavy wrapping paper, and only the selvage edge is exposed. In a well kept stock the smoke will not get much chance to reach the light colors; but water will damage them materially. Similar trouble will be encountered here as in

the silks, due to colors running, but not to the same extent. In plain colors, such as dress goods are usually made of, the colors are not nearly so likely to run as in silks, where one piece may have half a dozen colors, and if one of them runs the whole piece will be spoiled. A feature we have to contend with here is shrinkage. The different weaves are affected differently, the looser the weave the more likelihood there is of shrinkage. What is known as flannel cloth is a very loose texture, and heat or hot smoke will draw it up or shrink it. Broadcloth is affected by water which spots it; but all wool will not spot as much as the cheap grade. What is commercially known as union is part cotton and part wool, and water is sure to both spot it and spoil the nap. The adjuster must not be deceived into making allowance on some of the opera shades, where the damage has been caused by fading. If these light colors are kept in stock any length of time they are sure to fade, even through the paper covering. I have seen a mauve and some shades of purple and plum fade perceptibly, even when kept in a cardboard box where the light could not strike the box.

EMBROIDERIES.

There is a great deal of value in this department, and it is all staple white goods, with a possible exception of a few colored edges and feather stitched braids, which have colors in them. These colors are all supposed to be fast, but there is a peculiarity about colors running. Plenty of the so called wash colors will wash, and the colors will not run; but if the same goods were wet or left in wet boxes the color would spread and stain the whole piece. The reason for this is that in washing colored materials care is taken to thoroughly rinse the article, so that the color that might come out does not get a chance to settle on the material and stain it. After it is rinsed it must be dried quickly so that the color of the pattern will not spread in the wet material. Quite often embroideries are found that have a brownish cast, which is often attributed to water or smoke stain. Embroideries will turn that color from age. If the color is caused by water it will always leave an uneven stain, while if from age the color will be uniform. Any material that has been wet must be thoroughly dried before an effort is made to sell it. If this is not done there is always the danger of mildew. With any white material a merchant is likely to think that, as the goods are intended to wash, water will not injure them to any extent. I believe this is the reason why there is often so much subsequent damage from mildew in white goods. In other classes of goods, where other results are expected, care is taken to thoroughly dry the material. While in white material, where no damage is anticipated, no precaution is taken.

GENTS' FURNISHINGS.

This department is made up of all classes of goods that are used by men. Hosiery and underwear in the men's goods will damage about the same as in the women's, but are more easily disposed of. Shop wear must be watched for here, and particularly so in a certain class of underwear which comes in shades of brown, blue and pink, as this invariably fades from being exposed to the light. One feature of the men's department is that women quite frequently do the shopping, and the fact that a garment is damaged will not in many cases deter them from purchasing it if only it be reduced in price. Men's laundry goods, such as shirts, collars and cuffs, when damaged will always sell at a fair price, and in the work shirts the damage is very light. The damage to a man's glove is not as great as to a lady's for it is heavy enough to be used in lieu of a workglove. Derby or stiff hats are almost worthless if badly wet or smoke stained, but the damage to fedoras, cloth and soft hats is much less since they are more easily reconditioned. Work goods of all kinds, trousers, shirts, jumpers, overalls and gloves are all damaged to a less extent than dress garments.

A 10 per cent. damage in a work garment might easily be a 50 per cent. damage in a dress garment. The work trousers, overalls and jumpers as a rule have metal buttons, and unless these are cared for will rust and rot the cloth next to the button, thus materially damaging the garment. Suspenders, arm bands, garters and any article with rubber in it will be badly damaged, as either extreme heat or water will take the life out of rubber. Cheap jewelry and collar and cuff buttons are mostly of metal and will tarnish. The colors in fancy neckwear will probably run, but the plain colors are better except that men's ties are frequently filled or padded with a wadding which if wet renders the neckwear useless.

MUSLIN UNDERWEAR AND INFANTS' GOODS.

These are usually kept in glass wall cases and are therefore not so liable to damage; although some parts of the stock are frequently found in pasteboard boxes, often on the floor under the counters. They should be moved off the floor at once and the garments dried out. Water will leave a stain which should wash out in any white goods the first time they are laundered, but which will affect the selling value. If smoke stains a sheer material, and this department is nearly all sheer material, the stain usually goes through to the other side, when radical measures are required to remove the stain. Of course the fact that goods are white is a big advantage, as they can be boiled. It is sometimes difficult to tell the difference between a bad smoke stain and a scorch. If the material is scorched it will tear as soon as it is handled. A smoke stain will not do this. Infants'

goods and muslin underwear are frequently trimmed with ribbons, sometimes colored and sometimes white. The danger of the colors running in these is slight, as wash ribbons are generally used.

LADIES' HOSIERY AND UNDERWEAR.

In this department the stock is usually kept in the original carton. They are frequently of a bright color, either red or green, and water will cause this color to run and stain the merchandise, resulting in an extensive damage. Except for this the loss will be light. Woolen underwear is always subject to shrinkage and the light colors will show stain. Extreme heat will draw up the material and smoke will streak or stain it. A stain to woolen is always worse than to cottons. A common method for taking out stains is to boil the article; but woolens should not be boiled, as they would shrink too much, and the vitality would be taken out of the fabric. If this stock were kept in boxes made for the purpose, which are usually of a heavy cardboard, or wood, the damage would be very light, as the water would not be likely to reach the stock. If it did it would not discolor it, and the damage would only be the slight cost of time and labor in drying. These boxes are also a very effective stop to both heat and smoke.

PAPER PATTERNS.

It would pay an uninsured merchant to have a special case made for his paper patterns, as this stock is very susceptible to damage. There is either a total loss or no loss. Patterns are made of a very poor quality of tissue paper. One pattern consists of a number of pieces of this paper which must retain their original size and shape absolutely; as the least difference in one piece will render the whole pattern useless. Water even in the smallest degree will stick the tissue paper together, or shrink it so that it cannot be used. These patterns are kept in a case made up of a great number of pigeon holes. This case is usually of wood of a very light weight, and the patterns are in envelopes, which quite frequently are too long for the case. If a case were made of heavier wood, zinc lined with a drop front or glass doors, it would be a very effective preventive against damage, and would be well worth the expense.

WASH GOODS.

These are less liable to damage from water, as they are made purposely to wash. But there is always the danger of colors running and the term "wash goods" is in many instances a misnomer. The better grades of wash dress goods are kept in the same manner as silks, and the same class of damage obtains. In all of the sheer materials a dressing is used to stiffen and give

body to the fabric. If they are wet, even granting that the color will not run, the damage will still be considerable, as the fabric will lose its body. This material will launder and look well; but the fact that it has lost its freshness will impair its salability.

The wash fabrics of the present time have various finishes; the most common of which is the mercerized. This is a hard gloss finish put on the cotton thread to make it appear like silk or linen. This finish is supposed to withstand washing, but it will never look the same after it has been laundered. Hence the damage from water will be much greater than in an ordinary fabric without fancy lustre. Shrinkage must also be watched for. A cheap quality of gingham will shrink as much, if not more, than any other fabric. The adjuster must not let any shop wear be passed as smoke, fire or water damage. All the so-called party colors if kept near a strong light are very likely to fade or streak.

TABLE LINENS, TOWELS AND DOMESTICS AND HOUSEFURNISHINGS.

Sheets, pillow cases, table linen and towels are only damaged by water, as far as salability is concerned. Towels sometimes have colored borders and these may be affected. Silkolines and cretonnes are usually only prints, and for this reason the colors will readily run. Blankets are shrunk before being finished, and water will shrink them little, if any. As in other goods, the poorer the quality, the greater the damage. Curtains in the best quality are usually not dressed, and will not damage much from water. In the cheaper qualities, the starch will soften and the curtain will lose its shape. Strong smoke, or intense heat will draw the mesh of curtains and materially damage them. Comforters are filled with either shoddy, cotton, wool or down, and are covered with various materials, such as silkoline, cretonne, silks or satins. The down or wool filled can be renovated or restored to normal condition after either smoke or water damage. If the comforter is of a better grade, it will usually pay to figure on recovering; and if necessary, renovate it. The poorer qualities will not stand the expense. The cotton or shoddy will pack when wet badly and are of no value.

ART GOODS AND EMBROIDERY SILKS.

The time of the year governs the quantity and style of the stock on hand in this department, from August to January being the heaviest season. Along about August or September the stock for the Christmas fancy work arrives, consisting of white underwear, aprons, centre pieces, tray cloths, doilies and other pieces too numerous to mention. The colored pieces consist of crashes, mummy cloth, natural and colored linens, denims, satin, silks, and other novelty materials. These are in shape of table covers, pillow and pin cushion tops, scarfs and novelty bags. All of the above are stamped or the patterns are stenciled in colors to be

embroidered or worked in embroidery silk, cottons, or novelty twist. As the holiday season approaches the stock of materials decrease and made up or finished articles commence to arrive. The damage from water or smoke stain is very great, particularly in the colored materials. They are practically all of solid colors, and one would not suppose the loss would be as great as in piece goods. In fancy work the value of the finished article is 50 to 90 per cent. labor. A centrepiece, for example, might cost two dollars for material and be worth twenty dollars finished. If the material were damaged 50 per cent. the piece could not sell for more than ten dollars, which would be scarcely more than half the cost of labor required to finish it. Of course this is the case only in the colored or novelty pieces that will not wash or satisfactorily clean. In most of the white pieces the damage will be much lighter, as they are usually soiled from handling and must be washed after the work is finished. There is one exception to this: in the case of sheer aprons on which embroidery is to be worked, and the piece finished with either lace or ribbon, extreme care is taken to keep the piece clean, so as not to necessitate washing, because laundering will destroy the appearance of newness in any piece of sheer material.

Novelties are usually kept in packages or boxes containing the stamped piece with silk or cotton necessary to complete it. The damage possible from smoke is lessened by the paper or box covering; but as the colored silks are in contact with the material, the possible water damage is very great, due to water causing the color to run in the silk. Embroidery silks in skeins have no value when wet or thrown around, as they become rough and cannot be worked, except possibly in the rope or twist silks, which have a harder surface. Floss and down pillows are kept in this department. The floss pillows are a total loss if badly wet, as they will surely mat; whereas down pillows can be renovated; thus the damage would only be the cost of renovating. It is true in every department and in every class of goods that the damage to necessities or staples is far less than the damage to novelties. A novelty is always for show or for a gift, and when a person buys anything of that nature he will not accept a damaged article even at a greatly reduced price. While a staple, even if very badly damaged, always has a value. Another feature that must be watched for in this department is depreciation, due to change of style. Stamped patterns and styles of work change materially and often. When a pattern is out of style it is not worth very much on the dollar.

YARNS AND KNIT GOODS.

are very susceptible to damage. Smoke stains them very quickly and water will shrink or cause the colors to run. The domestic yarns are more liable to shrinkage than the imported, which is

due to the way they are manufactured. The domestic are only washed once in the making, while the imported are washed three times and are supposed to be thoroughly shrunk, although the best of them will shrink to a certain extent. Shop wear and fade in yarns will occur even with the most careful merchant. Some shades will fade if exposed to the light, and will often fade even in the box, if they are kept in stock any great length of time. This damage must not be confused with fire damage. Shawls, caps, slippers, underskirts, jackets, and numerous other articles made from yarn are all subject to the same class of damage, that to the staples always being lighter than to the fancies.

READY TO WEAR GOODS.

This is a very extensive department, and one where the values fluctuate considerably, as they are all seasonable goods. Petticoats or underskirts are made of various materials, and the damage to these is the same as in the goods by the yard. Waists are made of silks, satins, wash materials, woolens, and novelty goods. A silk or satin waist that is damaged is often a total loss, as a small spot may spoil the whole waist. The silk and satin waists are kept in boxes, with the exception of a few that are on forms in the different parts of the store. Naturally those kept in boxes are not so greatly damaged, while those on the forms are likely to be a total loss. All silk waists will be badly damaged unless they are promptly dried. Wash waists are affected the same as the material, but will unless very badly damaged sell at a price. Woolen or flannel waists are very liable to shrink. Quite a few fancy dress waists are made of chiffon, voile, mousseline de soie, and net, and these are nearly always lined with silk or satin. The damage to any of these is considerable, but a chiffon or mousseline is worthless, if wet; in fact, the only material of them all that can be renovated is the net, which will wash if the lining will permit, or it will at least clean very satisfactorily. Suits are usually kept in full length centre or wall cases, and if these are closed at the time the fire occurs the chance for loss is very slight. A damage that can be avoided and that often occurs is caused by water being left on top of the cases and seeping through to the garments, streaking and staining them. If these cases or all cases and fixtures were dried off on top and covered with an oil cloth, which would cost about 20 or 30 cents a yard, the saving would be great. When suits are wet they are badly damaged through the lining of the coat or jacket shrinking and throwing the garment out of shape. Often the material will shrink and leave the lining showing all around the bottom. Sometimes the jackets and skirts of a suit are kept in different parts of a store, and one may be damaged or destroyed without the other being affected.

When this occurs the piece that is left is of little value. A separate skirt is worth something, but a jacket, unless it could be used as a long coat, would be worthless. Cloaks are often unlined or have little lining, and the material itself being heavy retains its shape; therefore they are not so easily damaged. Costumes, light dresses and opera cloaks are all very susceptible to damage, and it is a rather difficult matter to dispose of them. It would probably be advisable to recondition them, as no one will take the chance of investing so much money without knowing what could be done with the garment. A person who would ordinarily buy one of these light garments and pay a high price for it, would not take the same garment as a gift if it were damaged. Another person who would not ordinarily buy such garments might think them very cheap at the reduced price, but would not, unless in exceptional cases, think of buying them. A man's suit which would sell for $50 would, if slightly damaged, sell to a man who could not afford to pay the full price. In women's garments the styles are extreme, and those for whom they are intended would not buy damaged garments at any price; while those who could not afford the high price would not buy them, as the style would be unsuitable for their usage. Separate dress skirts are not used very much at the present time, and the stock would consist principally of walking skirts, which are not very easily damaged. In addition to these a few voile, etamine, or broadcloth skirts, principally plain colors, would be found, and these if wet would probably lose their shape. The black etamine or voiles are apt to turn rusty. Children's dresses are usually kept in drawers in the lower part of wall cases, or under the counter, and water or smoke will find little chance to reach the garment. These are often affected by water running down the wall behind the cases and entering the drawers from the rear. This is a very bad damage as it is not anticipated, and frequently is not discovered until every garment in the drawer is affected. The children's dresses are generally of wool or cotton, and are not damaged as badly as women's garments, as they are practically all staples and have no fancy colors, and even if damaged would sell much more readily than a woman's garment.

GENERAL REMARKS.

Merchandise to the amount of thousands of dollars in a stock of this size is frequently kept under counters and in boxes on the floor, and often these goods are of a perishable nature. An adjuster should find out from the insured who knows where his stock is placed, exactly where all goods which are particularly susceptible to damage are stored and take immediate action in preventing further damage, and thus save money both for the insured and the companies. The amount of money saved will

be governed greatly by knowing where to look for damage and where to expend your energies. The commonest water damage that is encountered, and one that is not confined to this class of store is caused by the water running down the walls and lodging on the back part of the shelves and sometimes into the drawers. This condition unfortunately is often not noticed until it has caused extensive damage. After a fire occurs the only way that the loss can be even lessened is by moving all of the merchandise.

A merchant should not allow any case or fixture to come into contact with the walls. An inch air space would be sufficient, and all goods or boxes containing merchandise should be kept off the floor at least 2 or 3 inches. If these simple precautions were taken much unnecessary damage would be eliminated.

The knowledge of merchandise and the damage to it are two entirely different matters. It must be remembered that a merchant will always know more about his own stock than any adjuster; while an adjuster will know more about the effect of damage and where it will show. The adjuster, by being able to point out intelligently where the damage exists, and by convincing the insured that he is working in his interest as well as in the interest of the companies, he will gain his confidence, which is the keynote in all adjustments.

SPRINKLER EFFICIENCY.

Efficiency of Automatic Sprinklers in Risks of Various Occupancy.

By Henry A. Fiske, Fire Protection Engineer, Henry W. Brown & Co., New York.

The student of automatic sprinkler protection can well afford to carefully study and analyze in detail the results of such protection in various classes of risks as shown by the N. F. P. A. fire record, and comment on these results should be in order in any endeavor to give a clearer idea of the relative value of sprinklers in the more important classes. An analysis of the sprinkler fires throws much light on a very important problem of modification of the present standard sprinkler system where the occupancy seems to warrant either more or less than the standard and the student soon learns that while the average standard equipment is satisfactory for most risks, nevertheless in many cases the requirements are unduly severe to secure adequate protection, while in other cases additional protection is necessary to obtain the desired result.

It is of course evident that where the building itself is of noncombustible construction, with a minimum of combustible contents, as, for instance, a machine shop, a relatively weak sprinkler system would be effective in extinguishing fires, whereas in a frame warehouse full of cotton or other combustible the full standard is essential; and to go still further, in such risks as oil cloth drying buildings some special arrangement of sprinklers is necessary, owing to serious obstruction to distribution from stock.

A study of the sprinkler fires in various classes should bring out the weaknesses of sprinkler protection and also to some extent the factor of safety, which latter we may consider as the chance of failure with the average equipment in the average risk.

Let us first compare this factor of safety in a few classes and then take up those special classes where the hazard is particularly severe.

The following have a large number of fires reported, while the hazards are varied:

	Number of Fires.	Unsatisfactory Sprinkler Fires. Per Cent.	Unsatisfactory, Owing to Defective Equipment. Per Cent.	Fires, Complete Sprinkler Success. Per Cent.
Boot and shoe factories	368	3	1.0	77.0
Clothing factories	227	2	1.0	74.0
Knitting mills	432	5	3.3	68.0
Mercantile risks	362	3	0.3	77.0
Printers	259	5	2.0	77.0
Average, all classes	..	5	2.0	63.6

None of these risks have a hazard too severe for ordinary sprinkler control nor do they offer severe obstructions to distribution, but on the other hand they vary as to quick spread of fire and work which the equipment has to do, and by comparing the above figures we are led to the conclusion that the factor of safety is greatest in mercantile risks, shoe factories, clothing factories, and least in knitting mills, as with the latter the number of unsatisfactory fires with defective equipment is greater, while the percentage of fires entirely extinguished by sprinklers is less. In laying out equipment for such classes it would therefore seem proper to have a more powerful equipment than the average for knitting mills, with a less powerful equipment for mercantiles, etc.

As a matter of fact the more we study the fire record the more we are led to the conclusion that with ordinary risk (with no abnormal conditions as to hazard or obstructions) there is a very large factor of safety, and this leads to the inquiry whether in such risks the standard is not too severe. The expense of a sprinkler system is sufficient in many cases to prevent its installation, and as with all engineering problems where the expense must be considered, the factor of safety should not be excessive. It can hardly be disputed that a satisfactory sprinkler system can be provided at far less expense than the standard system, at least for risks of ordinary occupancy, and such a system might be designed to effectively supply, say, ten sprinklers for a period of thirty minutes. Especial attention would be given towards securing a moderately heavy pressure water supply which would give at least 25 pounds working pressure on the top floor with all ten heads in operation. So far as the sprinkler system itself is concerned 10,000 gallons of water should handle any fire in risks where obstructions or hazards are not abnormal, and on such a basis equipments could be designed and installed which would probably not cost over one-half the present average. Incidentally neither area or number of stories would effect this problem in such average occupancy risks.

The attempt to provide an equipment which will answer for all classes of occupancy and provide against all contingencies has led *to the use* of a standard with altogether too great a margin of

safety and an expense of installation which is not warranted in the ordinary risk.

In most classes of risks the hazards of occupancy are not too severe for the average equipment nor are the obstructions to distribution serious, and a study of the fire record shows the following prominent classes where these particular features are likely to affect sprinkler control: Celluloid, cereal mill, cooperage, cordage, cork factory, cotton warehouses, grain elevators, flour mills, furniture factories, match factory, oil cloth works, rubber works, saw mills, starch factories, varnish works, window shade factories, woodworkers.

The important features of each class as affecting sprinkler control with suggestions for increased protection or reduction of the hazard will now be briefly enumerated.

CELLULOID WORKERS AND MANUFACTURING.

The great danger is from celluloid in bulk, either sheets or scrap. A standard equipment should control any fire except for stock in bulk, and the natural answer is therefore to store all stock or scraps in detached fireproof vaults, with small amount in any one section. A fire in bulk stock of celluloid is practically uncontrollable, and explosions are likely to result; while if scattered in moderate quantities, as in the ordinary celluloid working establishment, celluloid fires are readily controlled by sprinklers.

CEREAL MILLS.

Dust explosions in this class of risk may cripple any sprinkler systems. The working rooms can be ventilated to reduce the dust hazard. Storage bins when not full may have a serious dust hazard, and the danger of ignition can be minimized by screens and magnets at the attribution mills, as the chief hazard is spark in the mills.

Sprinklers have shown excellent results in cereal mills, but full standard equipments with water supplies above the average are essential. Also this equipment should be complete as regards all enclosures such as elevator legs, enclosed machines in closets, etc.

COOPERAGE PLANTS.

Owing to the very serious obstruction to distribution from sprinklers especially where barrels are piled several tiers high, fire sometimes gets beyond control. The water supplies should have greater volume than is ordinarily needed and heavy pressure is also desirable. Barrels should preferably be stored in detached or cut-off building and not tiered.

CORK FACTORIES.

Finely divided cork dust is particularly liable to explode and sometimes with sufficient violence to break the sprinkler pipes

and cripple the system. This hazard can be largely overcome by means of blower and ventilating systems which will keep the room in which grinding is done sufficiently free from dust. It is also desirable to have the cork grinding processes in a building well detached from the main plant.

COTTON WAREHOUSES.

In a standard warehouse cotton bales are laid on end and never tiered. Where cotton is piled several bales deep as is generally the case in non-standard warehouses, the obstruction to distribution of water from the sprinklers is very considerable and fire is exceedingly difficult to extinguish. For such non-standard warehouses the water supplies should be well above the average as to volume and pressure.

GRAIN ELEVATORS.

Severe explosions from grain dust sometimes occur sufficient to at least partially wreck the building and break the sprinkler pipes. While the dust hazard cannot be eliminated it can be greatly reduced by blower systems and proper care in frequently cleaning up the dust especially around shafting and machinery where a fire is likely to start.

The construction of grain elevators is such that it is difficult to install an effective equipment and there are several unusual problems involved. Elevators settle and change their shape sufficiently to cause unusual strains in the sprinkler piping making it difficult to maintain such a system in good condition. Furthermore a dry system must be used and the proper location and arrangement of dry valves is very important.

While it is true that there have been several so-called sprinkler failures in grain elevators, it is also a fact that in most if not all cases the sprinkler equipments have been faulty and there is no reason to believe that a standard equipment will not take care of a very large percentage of grain elevator fires. It is of the utmost importance that sprinklers be placed throughout all portions such as elevator legs and boots, inside wooden machine enclosures, etc., and large volume water supplies are essential.

FLOUR MILLS.

Except as regards construction these risks present similar problems to grain elevators. The dust hazard can undoubtedly be largely if not entirely eliminated by proper blower and ventilating systems and with this accomplished the flour mill presents no particularly severe hazards. Owing to the fact that the spread of fire is probably more rapid than in the average risk it is well to provide water supplies of larger capacity.

FURNITURE FACTORIES.

The benzine dip tank is perhaps the most severe hazard met with in these risks. Even with first class sprinkler protection the dip tank hazard should be safeguarded in every feasible way, otherwise a large number of sprinklers may open and overtax the system. If the dip tank is provided with automatic cover and overflow pipe the ordinary sprinkler system should hold any fire in control. It is also advisable to have this hazard isolated as much as possible from the rest of plant.

In most furniture factories there is a serious obstruction to distribution from finished goods in stock rooms and also from lumber, the latter particularly in dry kilns. Finished goods should be kept in a storehouse either separate or cut off from main plant. They should be piled as low as feasible and never within less than two or three feet from the ceiling.

A full standard equipment is particularly advisable in furniture factories and heavy pressure water supplies of large volume are desirable.

MATCH FACTORIES.

The mixing of match paste is extra hazardous and explosions are likely to occur. If the room in which this work is carried on has a standard cut-off from rest of plant the fire should be confined to that room and controlled without difficulty by the ordinary sprinkler system.

In the work and packing rooms fires often occur and while they spread somewhat rapidly they should be controlled by sprinklers without opening more than the average number of heads.

OIL CLOTH WORKS.

Coating with benzine mixtures and drying constitute the chief hazards so far as sprinkler control is concerned. Where the drying is in rooms of considerable height and area the fire frequently gets beyond control of the ordinary sprinkler system, owing to the large amount of combustible material and the large number of heads opened. This with both the horizontal flat drying and the festoon drying. Such rooms require special treatment as regards sprinkler protection. If the height is over fifteen feet side of aisle lines can be installed, this being particularly necessary with the flat drying. The main supply pipes should be designed to properly feed all the sprinklers in the room when operating at the same time and this generally means water supplies of large capacity.

In small dry rooms or cells such as are used in the manufacture of table oil cloth it has been amply demonstrated that the ordinary sprinkler system will extinguish the fire without allowing it to spread to any extent.

RUBBER WORKS.

While large quantities of naphtha are used in most rubber factories the only hazards which would probably affect sprinkler control are rubber cloth coating and drying and other large dry rooms such as are sometimes found in boot and shoe factories. These dry rooms become filled with naphtha vapor and quick flash fires result opening all the sprinklers in the dry rooms and sometimes many in the rooms adjoining.

Full standard equipments are essential where these hazards exist, but as such fires are usually extinguished quickly the ordinary water supplies should be amply sufficient.

SAW MILLS.

The construction of many of these risks is such that a large number of sprinklers are likely to open and overtax any available water supplies. Very high studded ceilings and open ends carry the heat away from the sprinklers directly over the fire and in risks of such construction this cannot be well avoided.

The sprinkler must be designed to give good distribution from a large number of heads with large feed mains and short branches. Only a small number of sprinklers should be allowed on one dry valve, say not over 150, and dry valves should be located as near as possible to the sprinklers which they control. Water supplies should be of sufficient volume to feed 75 or 100 sprinklers at a time, and experience has shown that in many cases the water supplies were totally inadequate in risks of this character.

Obstructions to distribution are numerous and great care should be given to the proper arrangement and location of sprinkler heads.

STARCH FACTORIES.

Serious dust explosions have occurred in risks of this character sufficient to cripple the sprinkler system. This hazard can be minimized by proper blower systems, and similar remarks would apply as with flour mills.

VARNISH WORKS.

Open tanks of varnish if once on fire are almost impossible to extinguish with water. Arrangements for draining such tanks can be made and covers (preferably automatic) provided.

When rooms are not too large and there is plenty of boiler capacity live steam can be used to advantage. The storage of varnish in bulk should be in a separate building.

Even with good sized open tanks the water from sprinklers is of great value in helping to hold fire in check and the water seems to have a smothering effect. Such a fire will, however, *burn much* longer than the ordinary fire, and in all risks of this

class the sprinkler system should be full standard and have water supplies of large volume.

WINDOW SHADE FACTORIES.

The ordinary festoon drying of cloth coated with naphtha, paint or varnish, presents a serious hazard both as regards the rapid spread of fire and obstruction to distribution. In this class of risk the sprinkler system should be full standard and if rooms are of large area particular attention should be given to the arrangement of the riser and feed mains. Water supplies should be above the average, both as regards volume and pressure.

WOODWORKERS (ROUGH NOT FINISHING).

In this very large class of risk there are three main features affecting sprinkler control, viz., sawdust vaults, lumber dry kilns, obstruction to distribution from stock.

In the lumber dry kiln we not only have obstruction to distribution from the lumber itself but also frequently a blower system which aids in the spread of fire. With such a blower system arrangements should be made for quickly shutting down the blower, both automatic and manual. The dry kilns should be of small area and the lumber should not be piled close to the sides of kiln, nor should it be piled within two or three feet from the ceiling. Sprinklers should be spaced somewhat closer together in dry kilns so as to give an extra amount of water, and as such fires are particularly difficult to extinguish the water supplies should be of ample volume.

Explosions have frequently occurred in sawdust vaults and side walls should be heavily constructed with positive cut-offs from other buildings. Any fire in a sawdust vault should be entirely isolated regardless of sprinklers.

Owing to the fact that obstructions to distribution from stock are more severe in woodworkers than in any other classes of risk, the sprinkler system should be full standard with water supplies above the average both as regards volume and pressure.

IN CONCLUSION

it should be noted, that while there are a number of classes which show sprinkler failures due to the hazard of occupancy, nevertheless, as a whole the number of such failures is remarkably small. In over 12,000 fires reported about 75 can be classified under this head, which is not much over one-half of one per cent. Furthermore, with most of these classes, the majority of fires are controlled by sprinklers and in some of these classes the failures are a very small minority. When we take into consideration that many of the equipments are not in accordance with present standards, it will be seen that the occupancy hazard is comparatively unimportant when considering sprinkler risks as a

whole and with more attention paid to these hazardous classes, such as modern standard equipments and ordinary safeguards, we could reasonably expect that the sprinkler failures due to occupancy would be reduced to an almost negligible figure.

This leads us to again emphasize the belief that in the non-hazardous or better classes of occupancy, the present standard sprinkler system provides a large factor of safety and we could reasonably require a less expensive system for such risks without seriously affecting sprinkler control.

USE AND OCCUPANCY INSURANCE.

Origin, Elements, Development and Application of This Form of Coverage Explained and Analyzed.

By W. N. Bament, Chief Adjuster, Home Insurance Company, New York City.

Since the first fire insurance policy issued by an American company was written in the city of Philadelphia one hundred and sixty years ago, insurance, the "handmaid of commerce," has gone steadily forward, keeping pace with the marvelous development of the country, and we now have the insurance business of today with its hundreds of millions of capital, ready to meet every legitimate requirement of our social, commercial and industrial life.

During the past thirty years a number of new elements have been introduced into the business of fire insurance, among the more important of which may be mentioned electricity for light and power, automatic sprinklers, co-insurance and the subject of this address, "Use and Occupancy Insurance."

Any discussion of this branch of the business would not be complete without a consideration of the kindred subjects of rent, rental value, and profit insurance; in fact, use and occupancy insurance embraces all the others and more, and the former bears about the same relation to the latter as blanket insurance does to specific. Some attention, therefore, will be devoted to these and also to the closely related subject of leasehold insurance.

The New York form of rent policy reads as follows:

"The intention of this insurance is to make good the loss of rents, caused by fire or lightning, actually sustained by the assured on occupied or rented portions of the premises which have become untenantable for and during such time as may be necessary to restore the premises to the same tenantable condition as before the fire; * * but this company shall not be liable for a greater proportion of any loss than the sum hereby insured bears to the actual annual rental of the entire occupied or rented portions of the premises."

The framers of this form no doubt thought that it was perfectly clear, but, nevertheless, several questions present themselves in connection therewith. First, what is meant by "loss

of rents * * actually sustained by the assured?" Does this mean gross rents, as contended by some, and as frequently though not always construed in practice, or does it mean gross rents less those expenses which may be saved to the insured during the period of reconstruction, such as lighting, heating, elevator service, janitor service, collections, insurance and the like?

THE COURTS MAY ALWAYS BE COUNTED ON

to construe the contract most liberally in favor of the insured, and if they should declare that this class of insurance is valued, the rents being fixed amounts usually set forth in leases, then in the absence of a stipulation in the contract to the contrary, it would be construed like any other valued policy and the insurer would be liable for loss of gross rent without any deductions therefrom.

Although it is possible that they may so hold, we are hardly warranted, in view of their strong inclination to adhere in their decisions to the fundamental principle of indemnity, in concluding that they would go out of their way to discover a valued feature in a policy form, where there is no evidence except remotely inferential—of its existence. In fact, reason and justice would seem to point in exactly the opposite direction.

If the policy is not valued, it should be interpreted like any other contract of indemnity, and there is no more logical reason why one should recover more than his actual loss on rents than he should on any other kind of property. And the fact that the policy limits liability to loss on rents "actually sustained," lends emphasis to the view that the policy is not valued and these words, if they have any significance whatever, should be controlling.

The highest court in England, speaking through some of the brightest minds that ever graced the King's Bench, is unanimous in standing for the principle that under a contract of fire insurance, the insured in case of loss, shall be fully indemnified, but shall never be more than fully indemnified; that the insured is not entitled to receive anything by way of indemnity, if he has in fact sustained no loss; that in order to ascertain what a loss is, everything must be taken into account which is received by and comes to the hand of the insured, and which diminishes that loss. And the United States Supreme Court has declared in equally emphatic language, "If a loss happens, anything which reduces or diminishes that loss reduces or diminishes the amount which the indemnifier is bound to pay." (Chicago, etc., R. R. Co. vs. Pullman Car Co., 139 U. S., 79-88.)

Massachusetts, which departed from the principle in connection with the interest of a mortgagee (King vs. State Mutual F. Ins. Co., 7 Cush., 1), in another case, speaking through its

highest court, said: "The assured is only entitled to be put in the same condition pecuniarily that he would have been if there had been no fire." Two prominent decisions by the Court of Appeals of New York—Foley vs. Manufacturers and Builders Ins. Co. (152 N. Y., 131), and Michael vs. Prussian National Ins. Co. (171 N. Y., 25), have impressed many with the belief that said court has departed from the fundamental principle of indemnity, but a careful analysis of the opinions hardly warrants this conclusion. In the decision in the last named case which will be referred to later, it was the valued feature that over-indemnified the insured.

In the light of the authorities referred to, it is clear that unless the policy is a valued one, it is incumbent upon the insured, under a rent policy, to prove what his actual net loss is, after making proper deduction for everything in the way of salvage which may come to him.

In many cases there would be no diminution in the regular running expenses, but in event of a serious damage to or the total destruction of the building this might be a very important factor.

THE AVERAGE CONDITION AT THE END OF THE RENT CLAUSE

is not necessarily inconsistent with the foregoing basis of recovery, but in event of deduction being made from the gross loss for salvage in expense of maintenance during reconstruction equity would suggest a corresponding modification in the value when applying the average condition.

Nearly if not all rent losses are partial; the present forms, which differ somewhat in various portions of the field, have been in use for many years; the loss record has not been unfavorable; very little difficulty has been experienced in adjustments; settlements are usually made on a compromise basis, and many claimants no doubt take into consideration the salvage in expenses in their adjustment negotiations, so that this question does not arise very frequently as a practical proposition. A form could doubtless be prepared which would eliminate the element of doubt, which in the minds of many surround the present ones, yet the attempt would present its difficulties, and unless we experience more trouble in the future than we have in the past in the adjustment of this class of losses, and unless the necessity for a change becomes more apparent than it has up to the present time, it would be advisable to let it remain as it is.

Another inquiry which suggests itself is whether, under the above form, if certain portions of the premises are occupied by the landlord himself and not rented, the insurer would be liable for the rental value thereof. The term rent is hardly applicable to this condition, and the phrases "loss of rent actually sustained" and "actual annual rental" tend to confirm this view.

This condition should be covered under a rental value policy or as an element of use and occupancy insurance. But the particular form under discussion covers "occupied or rented portions," and this would in all probability be held to include occupancy by the insured.

RENTAL VALUE POLICIES.

are written at an advanced rate to cover loss of rents or rental value of the premises whether occupied or vacant at the time of the fire. The theory upon which this class of insurance is based is that the premises have a value as rentable property and may be rented at any time; hence, if destroyed by fire the insured may be deprived of the income which would otherwise accrue to him. It will also cover the rental value of that portion of the premises occupied by the owner himself. If not valued the amount of loss under a policy of this nature must necessarily be established by extraneous evidence.

If it is the intention of underwriters to cover the occupancy by the owner of the building under the rental value and not under the regular rent form (occupied only) in use in New York City, they can find room for improvement in the latter in respect of the words "occupied or rented," to which reference has been made.

LEASES CONTAIN ALL SORTS OF CONDITIONS.

and forms of policy covering leasehold interests are correspondingly varied. Under certain conditions a landlord and tenant may both have an insurable interest in the subject matter for its full value, and unless he has otherwise been fully indemnified each may recover from his own insurers the full value thereof. The landlord has an insurable interest as owner and if his tenant is under covenant to repair he is exposed to the risk of his tenant being unable to fulfill his obligation. On the other hand, a tenant who is under covenant to repair or restore the building in case of fire, has an insurable interest both by reason of his right to use the demised premises and by reason of this assumed liability to restore, and he cannot be fully indemnified in event of the building being destroyed by fire unless he recovers from his insurers the full value thereof. This does not constitute double insurance, and there is no right of contribution, as the interests are separate and distinct.

This would seem to imply a possible double indemnity, but the equitable doctrine of subrogation has been adopted to prevent this, and the great English decisions give this doctrine the widest scope and application by placing the insurers in the position of the insured upon payment of the loss, and giving them the advantage of every right or remedy whether in contract or in tort, or otherwise, which the insured himself may have.—Castellain vs.

Preston (1183), 11 Q. B. D., 380; Darrell vs. Tibbitts (1880), 5 Q. B. D., 560.

There is probably nothing stronger in the language of any court than Justice Brett's elucidation of the doctrine of subrogation as set forth in these decisions, in support of the principle that the insured is entitled to a full indemnity, but nothing more. This reasoning is so sound fundamentally that it is impossible to conceive of any court clothed in its right mind rendering an opinion at variance therewith.

There is a case in point in New York City, where the owner of a certain building carries insurance thereon (including improvements made by lessee), for its full value, several hundred thousand dollars. The lessee who is liable for rent and for all repairs, unless he avails himself of the statute and surrenders the premises, also carries a large insurance covering his interest. Four losses have occurred during the past few years, all of which have been paid by the lessee's insurers, no claim being made against the insurers of the lessor.

THERE ARE A NUMBER OF OTHER CONDITIONS supporting an insurable interest on the part of the lessee. He may have paid the full rental in advance with no right of abatement; he may have obligated himself to pay rent during the entire term of the lease even though the premises should be destroyed by fire. He has the right to the use and enjoyment of the demised premises. Very frequently the premises are sublet at a profit, and insurance may be taken out by the lessee to cover that interest; or he may occupy the demised premises himself, and owing to an advance in the value of the leasehold interest he may take out insurance to cover this increased value.

One of the most common forms of leasehold insurance is valued, and provides that if the premises shall be totally destroyed by fire the company shall pay the whole amount insured, less a deduction of a stated amount per month for the time that shall have elapsed between the date of the policy and the date of the fire. And in case of damage the company shall pay at the rate of a stated amount per month until by the exercise of due diligence the premises can be made tenantable. As in the case of all valued policies, care should be taken to ascertain whether the facts or conditions warrant the valuation stated in the contract.

The following comes from a Western city:

"A, the owner, leases the building to B; he sublets to C, and he in turn sublets to D, for the unexpired term of ten years; D agrees to pay a stated rental, and in addition to this a bonus of $50,000, in annual instalments of $5,000 each. In event of total destruction of the building by fire the lease may be canceled at the option of either lessor or lessee, but the above bonus

is to be paid in any event, and D takes out insurance to cover this liability. A, no doubt, has policies covering the building and rents. B probably has insurance covering his profit on the lease, and C, who may not care to rely absolutely upon the agreement with D, may also have insurance covering his profit."

We have here a chain of insurable interests which may be extended indefinitely, fairly rivaling in its possibilities the famous house that Jack built.

In Chicago a hotel company took out policies covering on the use and occupancy of a hotel, the loss to be computed from the date of the fire to the time when, by the exercise of due diligence, the building could be rebuilt. After the fire the lessor exercised his right to cancel the lease, there being 164 days still to run. The building could have been repaired in eighty-four days, but the insured brought suit claiming indemnity for 164 days. The court very properly held that the insured could collect for only eighty-four days. The hotel company should have taken out insurance on its leasehold interest instead of use and occupancy insurance.

INSURANCE IS FREQUENTLY WRITTEN,

covering buildings standing on leased ground, and under the policy conditions it is absolutely necessary for this fact to be indorsed thereon. It is self-evident that if a company writes a policy covering a building on leased ground, with the lease on the verge of expiration, with no privilege of renewal and with no option of sale to the lessor, it is tempting fate and playing with fire.

The Supreme Judicial Court of Massachusetts (two justices dissenting has held that the lessee of the land who erects a building thereon, which reverts to the landlord at expiration, has an insurable interest in the building for its full value, although the lease has only two years to run, the policy, of course, stating that it is located on leased ground. (Fowler et al. vs. Springfield F. & M. Ins. Co., 7 Ins. Law Journal, p. 189.)

The New York court, however, under a similar state of facts, held that while the lessee had an insurable interest, it was not for the full value of the building but for the value of the tenement for occupation, subject to rent, during the unexpired term. (Niblo vs. North American Fire Ins. Co., 3 N. Y., Superior Court, p. 551.)

The New York court has also held that when, under the terms of the lease, the lessee had the right, at expiration, to remove the building erected by him, the lessor had no interest therein, and that the lessee was entitled to collect the full value thereof, notwithstanding the fact that the lease had only seventeen days to run when the fire occurred, and if removed it

would net the lessee only about 20 per cent. of its value. (Laurent vs. The Chatham Fire Ins. Co., 1 Hall R., 41.)

Profits and/or commissions must be insured as such, although in respect of lumber in the hands of a mill owner, and whiskey in the hands of a distiller, the insurer is liable for market value, which, of course, includes the manufacturer's profit. "Market value" clauses are now frequently inserted in policies covering on leather, whiskey, lumber, sugar and other staple products in the hands of producers, and this is virtually assuming liability for loss on profits in addition to the cost of producing the goods. Just how far this class of decisions or this practice may extend it is impossible to predict, but in cases where the insurer would readily write profit insurance and literally run after use and occupancy insurance, the market value clause may be viewed with comparative equanimity, provided it is accompanied by that automatic regulator—a co-insurance or reduced rate average clause.

When insuring commissions and/or profits, the form should limit the liability of the insurer to not exceeding a certain per cent. of the sound value of the stock, and it should also contain a stipulation that the loss on commissions and/or profits shall not, in any event, exceed said per cent. of the amount of damage which the merchandise shall be found to have sustained, irrespective of whether said damage be ascertained by agreement, by appraisement, or whether the stock be surrendered to the companies covering the same, and the net loss ascertained through sale of the salvage.

This may not in some instances be entirely fair to the insured, whose actual loss of profits may materially exceed the figure thus ascertained, but it affords an easy method of adjustment and is probably as liberal a contract as the companies can safely issue.

The advent of automatic sprinklers, the prompt recognition by the New England mutual insurance companies of their value as the greatest of all agencies in the line of fire protection, and the failure on the part of stock companies to recognize their importance as an underwriting factor, resulted in the transfer of a large portion of the insurance on textile mills in New England from stock to mutual companies. And it was with a view of counteracting this diversion that Henry R. Dalton, of Boston, and A. W. Damon, president of the Sprinfield F. & M. insurance company, devised the first use and occupancy form of which we have any record.

THE PHRASE "USE AND OCCUPANCY"

is somewhat vague and indefinite, and it is difficult to define with precision. It usually involves the idea of earnings or profits, but they are not necessarily synonymous terms. The New York

Court of Appeals has attempted to define it in one of the few cases bearing on use and occupancy insurance, but the light which that tribunal has thrown on the subject is darkness.

The case referred to is the celebrated one of Michael vs. Prussian National insurance company (171 N. Y., p. 25), which in any discussion of the subject requires special consideration. The policy was a valued one providing for the payment of a certain fixed amount for every day required for reinstatement. The insured, the Buffalo Elevating Co., which owned and operated a large elevator in Buffalo, entered into a secret pooling arrangement for the active season with other elevator owners, the agreement providing that after payment of certain operating expenses, the balance, to wit, 80 per cent. of the gross earnings of the Buffalo Elevating Co. should be turned over absolutely to the pool, and that the elevating company should continue to receive its full share of the entire pool earnings, even though their elevator should be destroyed by fire. The time required for rebuilding was fixed by arbitration at 259 days, and the total claim under 46 policies amounted to $60,328.87. The companies defended on the ground that there had been a change of interest in the subject of insurance and that the insured was not the sole, unconditional owner of the same.

The court held that notwithstanding the transfer of the total earnings to another, the insured was the sole and unconditional owner under a use and occupancy policy, that there was no change in interest in the subject matter described in the policies, and that the doctrine of equitable subrogation did not apply. The court said:

"Use and occupancy, as terms of insurance, may assume within their general scope, the expectation of profits and earnings derivable from property, but the terms appear to have a broader significance as to the subject of insurance, and to apply to the status of the property and to its continued availability to the owner for any purpose he may be able to devote it to. * *

"If the subject of insurance was the earnings and income of the elevator, then it was affected by the agreement in question. There was under that construction a change effected in their ownership, or in the interest of the assured and a consequent breach of warranty. If the subject of insurance was not the earnings nor the income, as the endeavor has been to point out, but the mere continuance of the elevator plant in a state or condition of availability for use and occupation, then it mattered not what was done with the earnings of the business so conducted."

Inasmuch as the insurance was held to be valid, the highest court in the State of New York has virtually held that insurance *of use and occupancy* is not insurance of earnings nor income.

And the unhappy phrase, "Use and Occupancy," unaccompanied by any explanation in the form as to what it meant, cost the insurers, under valued policies, over $60,000, and the insured were clear gainers by the fire to that extent.

A lower court in New York, in a later case bearing indirectly on the subject of use and occupancy, and referring to the Michael case, used the following language:

"But the profits of the business were quite another risk and not at all covered by the phrase 'use and occupancy.' Perhaps the market value of that interest may be as ascertained by proof in the absence of agreement, but it clearly does not consist of profits plus fixed charges." (Tannenbaum vs. Freundlich, 81 N. Y. Supp., 292.)

COMMENTING ON THE MICHAEL DECISION,

the learned text writer and counsel who handled the case for the defendants, well says that if the earning power and gross earnings of an elevator are no part of its commercial use, it is difficult to see what is. If an absolute transfer of the total earnings is no change of interest whatsoever in the subject matter of "use and occupancy" insurance, it is difficult to conceive what can be. And the layman, who in his daily practice as an adjuster of losses under use and occupancy policies, not valued, is accustomed, in figuring the value, to allow from 90 to 100 per cent. thereof for net profits, may well ask, what elements or items capable of being expressed in dollars and cents really go to make up the value of this mysterious something known as "use and occupancy" if earnings or profits are not at all covered by the phrase?

The court seems to have looked upon the words as vague and indefinite and in order to avoid a forfeiture apparently chose to regard it as a collective term not subject to analysis or too minute inquiry into the various elements going to make up the value of the entire subject matter. The decision may have been warranted, and in the strictest sense, may have been legally sound, but it was inequitable, like many another—based on that convenient apology—"ambiguity," and if at some future time under different conditions the learned tribunal which gave expression to the foregoing opinion is called upon to decide just what is to be taken into consideration in arriving at the value of the use and occupancy of a plant, the insurance fraternity will be greatly interested in learning what it has to say on this subject.

USE AND OCCUPANCY INSURANCE

is written covering against loss caused by either fire, lightning, windstorm or sprinkler leakage, the most common being fire and lightning. There has been a feeling which still exists in some

quarters, that this class of insurance tends to increase the moral hazard, but probably on account of the discriminating care on the part of companies in selecting their risks the record thus far has failed to justify these fears. This class of insurance

CANNOT BE WRITTEN INDISCRIMINATELY;

in fact, it would be against public policy for it to become universal. It cannot with safety be granted to any individuals, firms or corporations except those of the highest standing doing a profitable business, and it calls for the utmost good faith on the part of the contracting parties.

In a distant city, some time ago, a comparatively small fire occurred in the assembling department of a large manufacturing plant which consisted of sixteen buildings. This department was the one which of all others, could be shut down and discommode the insured the least, and on the basis of the payroll, it constituted as a factor in production a little over five per cent. of the plant.

The adjusters figured the actual use and occupancy loss at less than $1,000, but claim was presented for $27,000, or $9,000 per day for three days, just as if the entire plant had been thrown out of commission; and in addition to this, $9,000 for profit on stock which had been destroyed, making a total claim of $36,000, which modest figure was subsequently raised by the filing of amended proofs for $61,000.

The form provided that if any of the buildings or the contents thereof should be so damaged, destroyed or disabled so as to entirely prevent the insured from producing "finished goods," the companies should be liable per day for each working day of such prevention, for an amount not exceeding the net average daily yield of the plant for three hundred working days immediately preceding the fire. It also contained the usual provision in regard to partial prevention. It did not, however, contain any element of co-insurance and the insurance actually carried amounted to only thirty-five per cent. of the annual net profits.

The insured contended, not that they were entirely prevented from carrying on their business of manufacture, but that they were entirely prevented from producing "finished goods"—as if the production of finished goods did not require the use of the entire plant, but only the finishing department. During these three days they were producing finished engines, finished transmissions, finished bodies, and all such parts, but in the opinion of the insured's counsel, all this counted for naught, because they were in the business of producing finished automobiles.

The claim was finally compromised for $10,000, but if the word "finished" can, in a given case engross the attention of

three firms of attorneys, consume several thousand dollars in expenses, and protract the adjustment of a three days' partial loss for fifteen months, it would surely seem as if it were a good one to eliminate from the use and occupancy form.

IN ORDER TO DETERMINE THE AMOUNT

of insurance to be carried, a conservative manufacturer ought to take the net profits for the preceding year, add a certain percentage for expected increase, if any, during the coming year, and an additional amount to cover fixed charges which cannot be dispensed with, for the period of total or partial prevention.

In probably no branch of the business is there a greater variety of forms than that which deals with Use and Occupancy insurance. The regular printed forms of no two companies and no two brokers read exactly alike, and each has special forms to meet the real or imaginary requirements of particular risks. But notwithstanding this lack of uniformity, virtually all contracts of this nature have some points in common.

All policies of this class contain some limitation as to liability. These limitations assume different forms, and among those most frequently used may be mentioned the following:

One three-hundredths of the amount of the policy for each day of total prevention;

Such proportion of the actual loss of net earnings that the amount of the policy bears to the net earnings for three hundred working days of twenty-four hours each, immediately preceding the fire;

A stated amount per day for each day of total prevention, said limit usually being one three-hundredth of the amount of the policy on the theory that three hundred working days constitute the average working year;

A stated amount for each working day of each particular month, for instance, $60 per day in the month of December and $40 per day in the month of January,—this form being used in connection with certain classes of risks where the working season is limited to six or seven months, as in cotton seed oil mills.

PROVISION IS ALSO MADE FOR RATABLE LIABILITY

in event of partial prevention, and it is right at this point that the ingenuity of the underwriter comes into play in his effort to construct a form which will be clear and concise, and fair both to the insured and the company. And if anyone thinks it is an easy task to prepare such a form, which will be free from criticism, and at the same time retain the good features of the existing forms, he can soon be disillusioned by making the attempt.

Many of these forms are, and all of them should be, modified by prefixing the words "not exceeding" to the above limits, the purpose being to prevent over-payment in event of any material falling off in business activity. Some doubt, however, has been expressed as to whether even these words are sufficient to eliminate the valued feature. When the insurance is valued, special care should be taken to guard against over-insurance.

In writing this class of insurance the permits and limitations usual to regular fire insurance policies (vacancy and non-occupancy permits excepted) are ordinarily included in the form.

Use and occupancy insurance is not ordinarily written with a co-insurance or reduced rate average clause, but in some contracts the element of full insurance, in one form or another, like the traveling salesman's suit of clothes and the protective tariff, is there all the same.

THE DIFFERENT CONTRACTS IN USE

are so numerous that it will be possible to consider only a few selected at random.

The following is a fair sample of one class of forms quite generally used:

$....................On the use and occupancy of..................
......located at..

It is agreed that if by reason of fire on the above mentioned premises, the assured shall be wholly prevented from producing finished goods, then this company shall be liable for an amount not exceeding $.................. per day for each working day from date of said fire to date (whether the same fall within the term of this policy or not) when production of such goods might, with reasonable diligence, have been recommenced. But if the normal production be diminished only, then shall this company be liable for that proportion of said per diem in which such production is diminished, it being understood that under no circumstances shall this company be liable in the aggregate for more than the amount of this policy.

In case of stoppage of production by fire, as above specified, the average daily production of the twelve months immediately preceding the fire, shall, for the purpose of this policy, be assumed to be the normal daily production.

In the first place, the words "producing finished goods" should be amended by eliminating the word "finished," if for no other reason than that set forth in the incident to which reference has been made.

It will be noticed that for total prevention, the limit of liability is fixed at not exceeding a certain amount per day, but no provision is made for ascertaining the actual loss per day. The reference to the normal daily production has to do only with the basis of settlement for partial prevention. If therefore, for some time previous to the fire, the plant had been producing much less than its normal output, the question which naturally presents itself is, what would be the per diem loss under the policy for total prevention? Would settlement be based on the

output at the time of the fire, the average daily production for the preceding twelve months, or the maximum capacity of the plant irrespective of the actual record previous to or at the time of the fire? I am inclined to think that in the absence of a provision to the contrary, the insured could enforce a claim on the basis of the real capacity whatever that might be, under the conditions then prevailing up to the per diem limit, the same as he could collect full rental value, whatever that might be, up to the limit under a rental value policy.

According to this view the words "not exceeding" would lose much of their force, but conditions might arise where this limiting provision would be very important. It might, moreover, be possible for the insurer to prove that under the conditions prevailing, neither the maximum nor the average capacity could have been maintained even if the fire had not occurred and that this might affect the value of the use and occupancy.

If, at the time of the fire, the plant should be running at a capacity much in excess of normal, it is easily conceivable that a severe fire might reduce the capacity considerable, but not below normal, in which event there could be no claim under such a form. And conversely, if at the time of the fire the output should be much less than normal, the insured might be correspondingly benefited. It follows, of course, that a form which is capable of producing these results, is not free from criticism.

It has, however, several points in its favor. It has a limit of liability in event of total prevention; it affords an absolute basis for settlement in case of partial prevention, and provided the per diem limit is not exceeding 1/300 of the amount of the policy, and not less than the normal average yield for the preceding twelve months, it saves to the company the element of full insurance and the advantages to be derived therefrom, which is something that both parties to the contract doubtless have in contemplation when the policy is written. This form, notwithstanding its defects, is quite as fair to the insured as it is to the company, for the former knows at all times how the business is running and can regulate his insurance accordingly, while the latter knows nothing until after a loss has occurred.

The following form, from which I have eliminated the word "finished," is in use by a prominent company:

$..................On the use and occupancy of......................
..............Manufacturing Buildings situate at.....................
and known as ....

The conditions of this contract of insurance are, that if any of the buildings used for manufacturing purposes or machinery therein, shall be so disabled by fire occurring during the term and under the conditions of this policy, that the assured are entirely prevented from producing goods, then this Company shall be liable for an amount not exceeding...............
dollars per day for each working day of such prevention; and in case said

buildings, or machinery therein, are so disabled by fire as to partially prevent the production of goods, this Company shall be liable per day for not exceeding that proportion of......................dollars which the product so prevented from being made bears to the average daily yield previous to the fire, which for the purposes of this insurance is agreed to be the full daily average for......................working days immediately preceding the fire, not exceeding in either case the amount insured.

IT WILL BE NOTICED

that there is practically no difference between this form and the one first considered in regard to total prevention, but there is quite a radical difference in respect of partial prevention. The first makes the "normal production" the absolute basis of settlement in event of partial cessation. The second form does not make the "normal production" or the "average daily yield" the absolute basis of settlement, but simply utilizes the average daily yield previous to the fire as one element in determining the proportion of the per diem limit in event of partial prevention.

Under the first form, the ——— "normal production," i. e., the average daily production of the twelve months immediately preceding the fire, would be the basis, and if, as has been pointed out, the actual production after the fire equals or exceeds the "normal production," there would be no diminution of the agreed production, even though there may be quite a diminution in the actual production as the result of the fire.

Under the second form, the actual productive power at time of the fire would be the basis, and the partial prevention percentage would be determined by the relative conditions which prevail at the time of and after the fire, taken in connection with the average daily yield prior to the fire. This may not be quite so easy of ascertainment, but the settlement will be fair to the insured in each and every instance. It is easily conceivable that under this form, a claimant might under certain conditions be able to collect the full per diem limit in case of partial prevention. This might happen in event of a partial shut down as the result of a very severe fire when the plant was running greatly in excess of its average capacity, for the figures might show a partial prevention equal to or in excess of the previous average daily yield, and this would, of course, call for the payment of the full per diem limit. This, however, is the natural sequence in all cases of under insurance, in the absence of co-insurance or average conditions.

On the other hand, in event of business depression, resulting in production falling below the average for the preceding year or agreed period, the amount collectible under the second form might be less than that collectible under the first.

It is quite apparent that in this latter form, the element of full insurance, which is supposed to be embodied in use and

occupancy policies, is lost to the company by reason of the condition relating to partial prevention and the insured in many instances may be correspondingly benefited.

This form might possibly be improved in thought, if not in diction, by changing the phraseology so as to make it read:

"This Company shall be liable per day for no greater proportion of not exceeding........................dollars than the product so prevented from being made bears to the average daily yield previous to the fire."

As it now reads, the limit for total prevention is "not exceeding .... dollars per day"—while the basis for partial prevention is a certain proportion of an absolute fixed amount.

ANOTHER FORM IN COMMON USE

provides that the company shall be liable for such proportion of the actual loss of net earnings ensuing from the use and occupancy of the premises as the amount insured bears to the total yearly net earnings based upon the daily average net earnings immediately preceding the fire. It also provides for the ascertainment of net earnings by deducting all manufacturing expenses from the total sales.

All the forms of this nature which have come to my attention are ambiguous in expression, but the intent is evident. This is the narrowest form of use and occupancy insurance, in that it embraces only one element, to wit, net profits. It has, however, the merit of including in its provisions the principle of the one hundred per cent. average clause, and if the cover were broadened—as it might easily be—and the phraseology improved, it would make one of the fairest conceivable forms both to the insurer and the insured.

The name "Use and Occupancy" is not a particularly happy one, and many attempts have been made to find a more satisfactory term to express the idea. The latest suggestion is "Business Interruption Indemnity" and a prominent company has evolved a form from which the following paragraphs are taken:

"It is understood and agreed that the term 'use and occupancy,' as herein used, shall be construed to mean net profits; general maintenance, to the extent of taxes, heating and lighting; and legal liability of assured for royalties and salaries and wages of employees under contract, as follows: .... And if by fire occurring during the period of time named herein, the ability to produce the full daily average of goods be impaired, but not destroyed, then shall this company be liable per day for said actual loss sustained, in such proportion of a sum not exceeding $.........................as the product so prevented from being made bears to the full daily average product, it being understood and agreed that for the purpose of this insurance the average daily product for the twelve months next preceding date of fire will be considered the full daily average product."

The idea of explaining in the form just what is meant by use and occupancy, and taking net profits as a basis and adding thereto various items of continuing expense, is a most excellent one. This may not embrace all the items which certain applicants may desire, but any omissions can be easily supplied.

As under one of the other forms referred to, however, the company might in certain circumstances, be called upon to pay the full per diem limit for partial prevention.

IN ADOPTING A NAME FOR USE AND OCCUPANCY INSURANCE

the originators probably had in mind only the occupancy of the buildings of a manufacturing plant and the use of the machinery and tools therein. Many forms still restrict the insurance to buildings and machinery, while others include stock and still others use the broader term "contents." It has been suggested that such a form might include the profit on manufactured stock when it provides for indemnity in case the insured is prevented from "carrying on his business" as distinguished from "producing goods," the theory being that the only "use" a manufacturer has for finished goods "in carrying on his business," is to sell them and make a profit thereon. In fact, this is the exact phraseology used in connection with insurance on department stores and other non-manufacturing property, the main feature of which is profit on sales. These words should not be used in policies covering manufacturing risks, and profits on manufactured goods should be insured as such.

Raw material and constituent parts which come under the general description of stock are important elements in manufacturing, and the destruction of some ingredient or part might interfere very materially with the entire process, just as effectually as the burning of the picker room of a cotton mill or the power house of any plant; hence, raw stock as a factor in production, is a perfectly legitimate item in connection with this class of insurance.

Although use and occupancy insurance is most frequently written to cover manufacturing risks, yet it is used in connection with department stores, mercantile risks and other property of a non-manufacturing nature. When written on mercantile risks the forms are varied somewhat, the phrase "producing goods" giving way to "transacting their business" and the expression "production of goods" to "gross sales." In other respects, the phraseology is very much the same as that used in connection with manufacturing risks.

THE MOST REMARKABLE AND INGENIOUS FORM

which has come to my attention has recently made its appearance. *It covers the use* and occupancy of a department store, men-

tioning building and contents, and has a tabulated sliding scale agreement fixing the basis of per diem liability for each month in the year, said liability for prevention during each of the respective months (varying as such month may be the first, second, third, etc., up to twelfth), of total or partial prevention.

It also provides that the policy shall pay such proportion of the per diem limits named, as the amount of the policy bears to a stated amount, say, $50,000.00, this being the maximum amount payable even if the period of prevention should be the full twelve months. This feature on its face looks good, but according to the table, if a fire should occur, say on the first day of the busiest month, causing total prevention for one month, the loss to the companies would be about 22%; for two months 37%; for three months 50%, and for six months the insurers might possibly have a loss of 85%. These results are about the same as they would be under an ordinary policy where the insurance carried amounts to from forty to sixty per cent. of the value; hence, that which at first glance has every appearance of being full insurance, or over insurance, operates practically, under the conditions of the contract, as very pronounced under insurance.

THE QUESTION IS FREQUENTLY ASKED—

what period preceding the fire should be taken as the basis of adjustment in case of partial prevention? Some forms provide for settlement on the basis of the average daily yield for three hundred working days immediately preceding the fire; some on the basis of the average daily yield for the previous six months, and some for the previous three months; some from the time the policy is issued until the date of the fire; some for the corresponding season in the twelve months immediately preceding the fire, and some on the basis of a stated amount.

It might be supposed that the greater the normal or average daily yield for the agreed period preceding the fire, the better it would be for the insured, and conversely, the less the normal or average daily yield, the better it would be for the insurer. Under one class of forms which we have been considering, this conclusion is correct, but under another, just the reverse is true. Therefore, a broker or agent who is desirous of adopting a basis which will be most advantageous to his client, would do well to first consider the form in connection with its relation to partial prevention, for that is where the difference lies.

Several attempts have been made on the part of companies to adopt a standard form or set of forms for use and occupancy insurance, but all efforts in this direction have failed, probably for the same reason that this is apparently impossible of accomplishment in respect of other classes of insurance. In the first

place, the peculiar conditions connected with one man's business differs materially from those surrounding the business of another, and different forms are needed to meet their respective requirements; and furthermore, standard forms which might meet the needs of a large majority of use and occupancy insurers much better than the miscellaneous aggregation now in use, would interfere with the ingenuity of the broker, for, as one star differeth from another in glory, so does one broker's form differ from that of his rival in point of desirability, in his own opinion at least, although this opinion is ofttimes subject to revision after a loss has occurred.

Inasmuch as the only courts which have rendered any decisions bearing on the subject of Use and Occupancy insurance, have declared that it does not cover profits nor fixed charges, and one has gone so far as to say that profits, which are always an uncertain element and speculative to a certain extent, do not even form any basis for calculating the market value of the use and occupancy of a plant, (Tannenbaum vs. Simon, 81 N. Y. Supp., 655), it would seem desirable to have the form clearly set forth exactly what is intended to be covered.

The Court of Appeals, in the Michael case, very properly said that the defendant might have avoided all questions of construction if it had plainly stated that the business of the plaintiff, or its earnings or profits, was the subject of insurance instead of using such a vague term as Use and Occupancy. Although the subject has engaged the attention of some of the best minds in the business,

THE IDEAL FORM HAS NOT YET BEEN PREPARED.

Virtually all of those in current use contain some excellent features, and unless there is some material increase or decrease in the business activity of the insured, adjustments made thereunder ought to be reasonably satisfactory to all parties in interest.

USE AND OCCUPANCY INSURANCE.

An Address Before the Round Table Order of the Insurance Society of New York, January 14, 1918.

By William H. Koop, of New York.

(Stenographic Report by The Weekly Underwriter.)

Use and occupancy insurance to the assured is a question of what indemnity he will receive in case his plant is damaged or destroyed by fire; to the adjuster it is a question of how he is going to adjust his loss; the man behind the counter wonders how badly is the company going to be "stuck."

It is from the last point of view that I am going to discuss the subject this evening.

I desire, first, to direct your attention to a corporation which manufactures its product in Connecticut and sells that product in every city, town and hamlet in the country.

If we were to examine the records and contracts of that corporation, I venture to say we would find conditions somewhat in line with the following: We would find that the president's contract with the corporation calls for an annual salary of $25,000; the manager's, $15,000; the sales manager's, $10,000; the advertising manager's $10,000; the factory superintendent's, $7,500; royalties on machines and processes in use, $25,000. We would also find that the corporation has a bonded indebtedness of $750,000 at 6 per cent. interest, making an interest charge of $45,000, and that the corporation has agreed to set aside annually $30,000 for the redemption of the bonds when they mature. The advertising contract calls for an expenditure annually of $150,000. We would also find that a large portion of the corporation's output is sold direct to the public through the corporation's sales stations, which are located in the more desirable sections of the larger cities. There are at least twenty-five of these stations, and the annual rental of each is about $6,000, making in all an annual outlay for rents of these stations $150,000. The taxes on the manufacturing plant are about $5,000 annually, but if the plant were totally destroyed by fire the assessment would be levied on the value of the vacant ground and the taxes would probably be reduced to $1,500. The corporation's stock issue amounts to $1,000,000, on which it is at present paying 7½ per cent. dividends, or $75,000, making a total of $544,000.

There are other expenses, fixed charges and profits in connection with the conduct of this corporation's business, but those I have referred to are sufficient to illustrate the operations of use and occupancy insurance.

You will note that the outlay is in excess of $45,000 a month.

LET US ASSUME

that the plant located in Connecticut is totally destroyed by fire and that it will take six months to rebuild and resume operations. During that time the charges to which I have referred will continue in whole or in part, and the loss to the corporation, due to the meeting of these obligations (even under the most favorable conditions) will probably be somewhere between $225,000 to $270,000. From what source is this outlay to be met? If the money is taken from surplus funds it reduces the value of the stockholders' investments to that extent. To effect an additional loan would probably be difficult, owing to the previous bond issue, and in addition it would also reduce the stockholders' equity. To pay these expenses out of the money collected from the insurance companies for the destruction of the building and its contents is, of course, entirely out of question, as it would place the corporation in a position where it would not have the funds to rebuild and purchase new machinery. You can readily see that under such circumstances the corporation will find itself in an extremely embarrassing position, unless the officials have had the foresight to effect use and occupancy insurance. Now, what

PROTECTION

does use and occupancy insurance furnish, and how shall the amount of use and occupancy insurance which should be maintained be established? In the case of Michael vs. the Prussian National Insurance Company, it was contended by the attorneys for the company that use and occupancy insurance indemnified the assured against the loss of earnings or profits derivable from the use of a grain elevator. This contention was denied by the court. I quote from the judge's opinion as follows:

"If the contract was intended as one of indemnity against the loss or earnings derivable from the operation of the elevator plant, the words chosen were unfortunate and, in my opinion, too vague. 'Use and occupancy,' as terms of insurance, may assume within their general scope the expectation of profits and earnings derivable from property; the terms appear to have a broader significance as to the subject of insurance and to apply to the status of the property and its continued availability to the owner, for any purpose he may be able to devote it to. * * The terms made use of have not the accepted significance *contended for* by the appellant, and any doubt or ambiguity

should be resolved against it and in favor of the assured. Insurance on 'use and occupancy' evidently relates to the business use which the property is capable of in its existing condition."

You will note that the judge denied the contention that use and occupancy meant only profits and earnings; the judge evidently realized that such an interpretation of the policy would be too limited. He stated that use and occupancy had a broader application, and that the policy might include within its general scope the expectations of profits and earnings derivable from the property. Now, to try

TO BRING THAT HOME,

let us assume that a company insures a building; that a loss occurs and that for some reason the case is thrown into court. The attorney for the company goes before the court and says: "Your honor, our policy reads building. Now, what is building? It is the enclosing walls and girders and beams and floors and ceilings and roof, and the window sash, frames and doors. Your honor, that is what we cover." I think it is probable the court would say: "No, that is not what you cover, you cover a much broader subject; you cover everything which goes to make that structure a complete building, and you are, therefore, liable for any damage done to any part of the building. If it was your intention to limit your liability to the parts of the building you have enumerated, you should have stated so specifically."

So it is with use and occupancy insurance; it does not mean net earnings or profits only, but both of these may be considered when establishing the use and occupancy value.

AS I UNDERSTAND IT, THE PURPOSE

of use and ocupancy insurance is to indemnify the assured for the loss he sustains through the interruption of his business due to the fact that he is unable to use and occupy all or a part of a specified building, or buildings, or all or part of the contents, on account of either or both having been damaged or destroyed by fire. So far as I know, the courts have never ruled as to exactly what items shall be included when determining a use and occupancy loss.

In the case of Michaels vs. the Prussian National, to which I have already referred, the insurance was written under a valued form and the court rendered a decision in favor of the assured for the agreed value, and no statement was made as to how that value was established. A manufacturer usually receives a return from his business sufficiently large to cover certain fixed charges and to net him a reasonable profit, and if by reason of fire his business is so interrupted that the returns are not sufficient to cover those items, it seems to me the companies should make

good that loss to him. In the absence of specific ruling by the courts as to how the use and occupancy value of a plant shall be determined, it seems well to examine the literature covering the subject which has been issued by the companies.

Quoting from a circular letter to agents issued by one of the largest companies:

"The value of use and occupany is plain enough to those who investigate it closely. The natural question is, How much can a risk carry? It can consistently carry an amount equal to the fixed charges and profits, to speak generally, all of which would be provided by the normal operation of the plant. Each of the amounts should be for a period of a year, because a year's loss is possible under the policy, and for the sake of greater clearness the usual important items are set down below:

"Profit, interest on bonds, taxes, rent (if occupant does not own the plant), royalties for machinery or processes which have to be paid if the machines or processes are not operated, salaries (under contract), salaries of millwright foremen or others who must be retained in order to resume work promptly after damage is repaired, wages of watchman, fireman, engineer, cost of lighting, heating, attendance and general maintenance consistent with a condition of idleness. Any other yearly contracts which are necessary to the plant. Other consistent special items. Consistent total amount."

From the leaflet of another company:

"The losses occasioned by the shutdown of a plant during a busy season are numerous. First, the net profit ceases because goods are not produced or sold, and that item alone for the period of the several months required to rebuild after a fire would be a serious matter to most concerns.

"In addition to loss of net profit, there are numerous expenses which must continue day after day, if the plant is to resume operations later, viz., the superintendent, engineer and certain skilled workmen must be retained on the payroll; also watchman, fireman and office help must be kept and paid. Interest on notes, bonds, etc., must be met whether the plant produces any goods or not, and taxes or rent bills fall due with proverbial regularity. There may also be the expense of royalties or rent of special machinery, and perhaps other smaller items in addition to these, all of which amount to a very considerable sum of money which the plant is not earning if closed by fire.

"Such loss of profits and fixed charges may be guarded against by use and occupancy policies, which insure the payment of a certain sum per day for total shutdown, or a pro rata part of that sum for partial shutdown."

Instructions issued by companies generally are in line with the *foregoing. With* such literature in the hands of an attorney, it

seems to me that he would have to be a pretty incompetent specimen of his profession if he could not convince a jury that his client has sustained a use and occupancy loss if that loss is a loss of net profits and/or fixed charges.

THERE CAN BE NO QUESTION,

however, that to the layman the use and occupancy form frequently seen on policies is indefinite, and in order to overcome this objection some forms distinctly state what items shall be included in the coverage; as, for instance:

"It is a condition of this contract of insurance that if said building and machinery therein, or either of them, or any part thereof, be destroyed by fire occurring during the life of this policy, as to render them wholly or partially unproductive, this company shall be liable for such proportion of the loss of net earnings ensuing therefrom, etc."

This form limits the loss to the loss of net earnings, and might be entirely satisfactory for such risks and moving picture theatres, where there are no fixed charges, or, again, with a slight change in the wording would be available for certain retail stores. As an illustration: I venture to say that all or most of us were at one time or another in the barber shop which was located in the Equitable Life Building prior to its destruction. If the proprietor of that barber shop had carried use and occupancy insurance about the only loss that he would have been legitimately entitled to under that policy is a loss based on his net profits, for he probably had no expenses that did not cease with the destruction of the building; the form to which I have already referred would have given him full protection.

AS A FURTHER ILLUSTRATION

of forms which distinctly specify what items shall be considered in connection with the use and occupancy insurance, I quote:

"The purpose of this insurance is to protect the assured against the loss of the use of the premises, loss of profits, loss of advertising and other expenses contracted for; loss of all fixed charges and loss of such sums as are necessary to be paid by the assured for the purpose of retaining the employees (whether under contract or not) in order to maintain the organization."

I believe the practice of distinctly stipulating what items shall be included is a good one and should be encouraged.

Now, gentlemen, let us next examine some of the forms to ascertain what portions of a plant must be damaged or destroyed in order to make the company liable for a loss of use and occupancy. This first form at hand reads:

"It is understood that if said building and machinery therein, etc."

You will note that under this form the interruption to business must have been occasioned by the destruction of or damage to building or machinery. This form, in certain classes of risks, is entirely satisfactory, as, for instance, electric light and power stations, Turkish bath establishments and the like. In others, the limitation may work a hardship upon the assured.

DURING THE PAST SIX MONTHS

I was told of a case where the assured was a manufacturer of ladies' silk undergarments. He had established an excellent reputation through good workmanship and the use of a distinctive and excellent quality of silk. A fire occurred on the floor below his factory, and his raw material was absolutely ruined for his purpose by smoke and water; the silk had become badly discolored. He promptly notified the mill to duplicate his previous order, and received a reply to the effect that there were so many orders ahead of his that the mill could not possibly comply with his request in less than sixty days. As a matter of fact the first shipment was made to the assured forty-two days after the fire. The building had not been damaged to such an extent as to prevent manufacture and the machinery had suffered practically no damage at all. His plant was inoperative for more than forty days, and yet technically the assured could not recover for interruption of his business under the use and occupancy insurance as written. Fortunately for him the company recognized the justice of his claim and paid the loss. A broader form and one occasionally used locally reads:

"It is understood that if said building, machinery or stock"; but even this form might not cover if the prevention of manufacture is due to the destruction of patterns. Another form reads:

"It is understood that if said building or the contents thereof," and still another reads:

"It is understood that if by reason of fire on the above mentioned premises, the assured shall be wholly prevented from producing finished goods, then this company shall be liable, etc."

Both of these forms, in my opinions, are sufficiently broad to give the assured the fullest protection.

THE NEXT IMPORTANT POINT

for consideration in the use and occupancy form is the limitation as to the per diem loss. Quoting from a form:

"This company shall be liable for an amount not exceeding $...... per day,"

or, again:

"Not exceeding 1-300th part of the amount of this policy for each working day of such prevention."

Many forms are in use where the words "not exceeding" have *been omitted.* This, I consider, bad practice, and from the com-

pany's standpoint the omission of the words should be discouraged.

Many manufacturing and other establishments experience a rush and slack season, and to pay for a loss of use and occupancy which occurred during the slack season at a per diem value fixed for the rush season seems almost criminal.

A policy was recently issued covering $150,000 on use and occupancy of a theatre, the per diem value being placed at $500 per day. The actual use and occupancy value of the property during July and August was nowhere near that figure. Subsequently the form was reviewed with the broker, and as a result the policy was reduced to $92,920; the form was revised so as to place a reasonable limit on the use and occupancy value for each month of the year. The values were established as follows:

For each performing day in the month of January, $500; February, $500; March, $500; April, $350; May, $200; June, $25; July, $15; August, $15; September, $250; October, $300; November, $400; December, $500.

A somewhat similar form was used in connection with the use and occupancy insurance of a department store. Payment per day: January, $5,000; February, $4,000; March, $4,000; April, $5,000; May, $5,500; June, $5,000; July, $4,500; August, $4,000; September, $4,000; October, $6,000; November, $6,500; December, $7,500.

Where no specific per diem limitations for different months are furnished, as they were in the last two cases, the per diem indemnity should not, in manufacturing or mercantile establishments, exceed 1-300th part of the amount of the policy, and in such risks as hotels, the limit should be on the basis of 1-365th part of the amount of the policy.

THE PER DIEM VALUATIONS

to which I have referred you will, of course, understand apply to cases where the manufacture of merchandise is wholly prevented. Many fires occur, however, where production is curtailed only, and to cover such losses several methods of adjustment have been devised:

"If the normal production be diminished, only then shall this company be liable for that proportion of said per diem in which such production is diminished."

You will note that in this instance the percentage of loss is based upon production, and the company would be liable for the same proportion of the per diem limit as the product prevented from being made bears to the normal product of the plant. If the production is reduced 30 per cent. the per diem loss would be 30 per cent. of the amount stipulated for total prevention of manufacture.

ANOTHER FORM

bases its partial loss on the reduction of net earnings. Where the insurance is intended to cover net earnings only this method is satisfactory, but under such conditions as the following and which were embodied in a form recently submitted, the company might be obliged to pay a sum far in excess of the assured's actual loss. It was stated in the form that the use and occupancy insurance was to include in its coverage net profits and fixed charges; the per diem use and occupancy value was to be at the rate of $250 per day, and in the event of partial loss the company was to be liable for that proportion of the per diem previously referred to in which the net profits were reduced.

Let us analyze the conditions of this form. Assume, if you will, please, that the normal output of the factory is 1,000 units a day, producing a gross profit of $250 daily, of which $200 goes to pay expenses of various kinds, and the balance, $50, represents the net profit. Lut us further assume that the establishment is visited by a fire and that the product is reduced to 800 units a day. The gross profit on the 800 units presumably would be $200, and would be sufficient to cover the expenses as previously indicated. The profit, however, would have been entirely wiped out.

Under the wording of the form the company would be liable for that proportion of the per diem first referred to, $250, in which the profits had been reduced, and inasmuch as they have been entirely wiped out the company would be obliged to pay $250, while the assured's actual loss would not exceed the loss of his profits, or $50 per day.

The form had been printed, and whether it was so worded by the broker, through ignorance or through deliberate intention, I do not know.

In order to establish the normal production of a manufacturing plant, it is customary to accept as such normal production the average product for a stipulated period just preceding the fire, as, for instance, the twelve months, the six months or the three months immediately preceding the fire; or, again, to accept as the basis of adjustment the normal production of the plant for the same calendar month of the preceding year. With a reputable assured any one of these plans would be satisfactory.

From what has been said you can readily realize the

IMPORTANCE OF STUDYING THE CONDITIONS

embodied in the form. That applies not only to the countermen, but applies to the broker as well. He should be sure that the insurance effected by him is such that it will properly protect the interest of his client.

Use and occupancy insurance should only be furnished where the moral hazard of the assured has been carefully investigated.

You can readily see how an unscrupulous manufacturer could arrange with an unscrupulous employee (who, for the sake of illustration, receives a salary of $5,000 a year) to sign a contract calling for a $10,000 salary, with the understanding that it is only to be used in connection with a loss under a use and occupancy policy. In case the plant is destroyed by fire, the employee's salary during the inoperative period is to be $6,000, and the remaining $4,000 is to go to the assured.

FULL INFORMATION SHOULD ALWAYS BE OBTAINED

as to machinery and raw materials in use. If the machinery is other than of stock pattern, or the raw material is not readily obtainable, the acceptance should be gauged accordingly.

I know of a case where there are in use four machines of Scottish manufacture, and each machine is about the size of this room. Each machine cost about $20,000 and produces eleven different patterns of a certain kind of merchandise. The manufacturer of the machines found that owing to the heavy cost there was little sale, and he accordingly, about twenty years ago, abandoned the model and is now manufacturing instead a small machine which turns out two patterns and sells for $5,000.

The owners of the four large machines state that it would be with the greatest regret that they would substitute the smaller machines for the four large ones now in use. They state that the aggregate floor area occupied by machines sufficient to turn out an equivalent number of patterns would be far in excess of the space now used, and it would accordingly increase the rent item. They also state that the four large machines can be supervised by fewer operators than a larger number of smaller ones would require.

Under these conditions you can readily see that with the model of the machine abandoned and the machines in whole or in part protected by patents, the patterns and models lost or destroyed, and the assured stating that they would not care to use the smaller machines, the company might have a pretty mean sort of a use and occupancy loss to adjust.

Another case comes to my mind where a necessary part of the raw material is a product of South Africa, and I understand that if that material should be destroyed by fire it would take about four months to replace. This condition might cause a greater loss than the companies expected.

While some risks may be tabooed when considering building or contents lines, still some companies might be willing to take a chance on the use and occupancy. Take, for instance, a one story frame building occupied by a power woodworker. The contents rate would probably be in excess of 5 per cent, the use and occupancy rate 75 per cent. of that figure.

If the plant were totally destroyed the one story frame building could easily be replaced in sixty to ninety days; the machinery is all of stock pattern and is easily duplicated, and the raw stock is not of an unusual character.

While the fire might cause a total loss to building and contents, the use and occupancy loss probably would not exceed 25 per cent. of the amount of the policy.

LADIES' COLLAR SUPPORTERS.

Brief Synopsis of Process of Manufacture and Fire Hazard Attendant Thereto.

Collar supporters, which have been very much in vogue for several seasons, are of different styles and shapes, but the process is similar in all cases. These shops are usually small affairs, widely scattered, and are found, not only in small buildings, but in lofts.

The process, briefly stated, is as follows:

A thin spooled wire is first placed on reel in a crimping machine, which crimps and cuts the wire in the desired length, usually three inches, and turns the cut ends into a circular form. These strips are put in a wire mesh basket, immersed in a thin solution of muriatic acid and water, usually one quart acid to ten gallons of water, washed in water, then to bath of one-half pound of cyanide potassium in five gallons of water.

After galvanizing, the supporters are placed in rows between thin strips of wood and dipped into white paint, dried, then dipped into liquid celluloid thinned with acetone.

If black supporters are wanted, the celluloid paint is colored with zapon black. When supporters are dried, they are fastened to cardboards for display and packed.

HAZARDS.

There is practically no hazard during the cutting, crimping and galvanizing process. The white paint used is thinned with turpentine for first coat. The dip pans are small, shallow, and hold about one gallon each, and have open tops, as have also the celluloid dip pans of same size. Scrap celluloid is always used, which should be kept in a fireproof safe or receptacle, and care should be exercised to keep scraps from under benches. Acetone, an explosive liquid, should be handled same as benzine. Not more than one day's supply of celluloid paint should be kept on hand. The drying ovens, usually, heated by gas, should be fireproof and well ventilated, either to the outside or to a brick flue. The presence of open pans of celluloid paint make it necessary to keep all open lights or fires from room. If, as in some cases, the ends of supporters are soldered, the gas mufflers should be in another room. All lights should be electric.

As the styles of ladies' collars change each season there are times when no supporters are used. The moral hazard is obvious.

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